







}

D E S C R I P T I O N  
OF A  
PORTABLE CHEST OF CHEMISTRY.

greeting

DESCRIPTION  
OF A  
PORTABLE CHEST OF CHEMISTRY;  
OR  
COMPLETE COLLECTION  
OF  
CHEMICAL TESTS,

FOR THE USE OF  
CHEMISTS, PHYSICIANS, MINERALOGISTS, METAL-  
LURGISTS, SCIENTIFIC ARTISTS, MANUFAC-  
TURERS, FARMERS, AND THE CULTIVATORS  
OF NATURAL PHILOSOPHY.

INVENTED BY  
J. F. A. GOTTLING,  
PROFESSOR OF CHEMISTRY AT JENA IN SAXONY.  
TRANSLATED FROM THE ORIGINAL GERMAN.

---

London:  
PRINTED FOR C. AND G. KEARSLEY,  
NO. 46, FLEET-STREET.

---

M.DCC.XCI.



---

---

## P R E F A C E.

THE following sheets are a translation of the German original of M. *Gottling*, a disciple of the celebrated *Wieglob*, and advantageously known to the chemical world by several papers, published in *Crell's Chemical Annals*, and various other treatises. The tests mentioned in the course of this work are prepared by Mr. *Hunneman*, a friend of the author, and pupil of the two great luminaries of chemical science, Messrs. *Klaproth* and *Hermbstaedt* of Berlin.

The

The chests are sold completely fitted up at C. and G. Kearsley's, No. 46, Fleet-Street; where any article, that may be expended, will be replaced, on application being made to the above-mentioned booksellers.

It is necessary to observe, that some deviations have been made from the author's original plan as given below; which, it is presumed, will be thought improvements; particularly in the construction of the chest itself, which is contrived in such a manner, that all the different tests may be seen at one view; the pestle and mortar, the funnel, blow-pipe, and scales and weights being placed in a drawer at the bottom; and under this last article, the four different coloured papers.

It will be likewise proper to observe, that the empty phial is intended for the *Hepatic Water*, as well as *Habneman's Wine-test*; as either of these tests may at any time be made extemporaneously from the powdered crystals of tartar, and the calcareous liver of sulphur.

If any farther explanation of the uses to which these tests may be applied is necessary, the reader is referred to *Wieg-leb's Chemistry*, which will give him ample information on the subjects of every one of the departments mentioned in the latter part of this treatise.

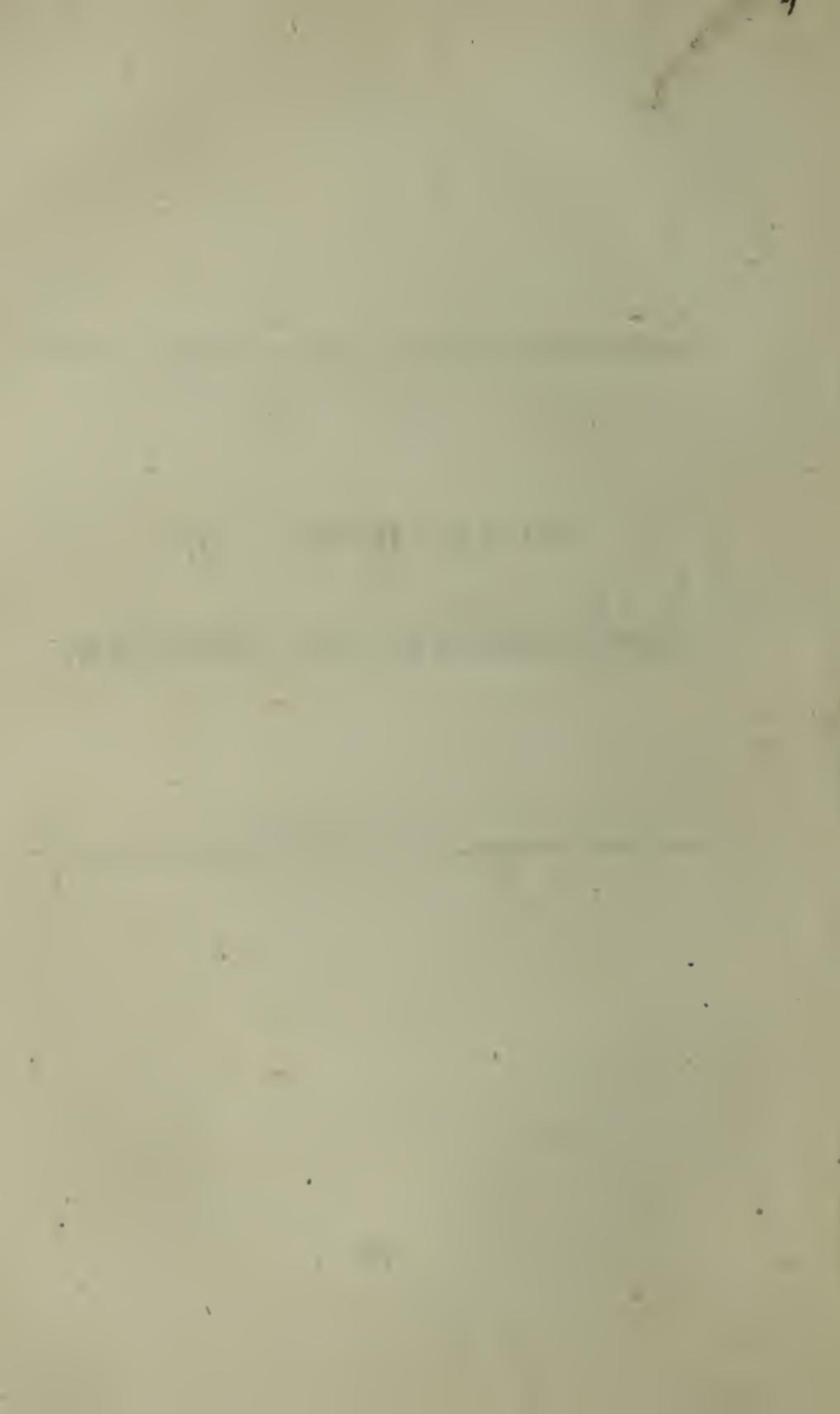
## ERRATA.

Page 10, between line 7 & 8 insert 13. Saccharine acid;  
15 & 16 — 22. Litmus.

P A R T I.

EXPERIMENTS IN THE MOIST WAY.

B



# INTRODUCTION.

---

WHEN in September, 1788, I announced\* the portable Chest, which, according to the prospectus, was to contain, *ready prepared for use, and in as pure a state as possible*, the principal *re-agents* with which we have become acquainted in these latter times through the medium of Chemistry, and which are indispensably necessary in the analysing of bodies in the *moist way*; I promised to publish a set of instructions, in which the use of these tests was to be explained in as distinct and perspicuous a manner, as the nature of the subject would admit.

\* In the *Chemical Almanack* or *Pocket Book* for 1789, a periodical work, published yearly by the author of this treatise. [E.]

It was long before I could resolve upon what plan I should pursue, in order that, while I was endeavouring to obtain the utmost brevity, I might lose nothing in point of perspicuity and clearness. To enter into a circumstantial detail of every cause of the phenomena which in such a variety of ways occur in the application of these tests, would have required a complete introduction to Chemistry. But as I have great reason to suppose that those, who intend to make use of this collection, are not without some tincture of chemical science, I deemed such a procedure unnecessary, and thought it would be sufficient to point out such appearances as are liable to take place in every case, in which these tests are combined with other substances. To this end I have made use chiefly of the writings of *Bergman*\*, *Struve*†, *Westrumb*‡, &c. but have constantly verified the doctrines advanced in them, by experi-

\* *Opusc. Phys. et Chem.* vol. i. pag. 93, &c.

† In the Supplements to the *Chemical Annals*, No. I. pag. 97 and 108; No. IV. pag. 82.

‡ *Physico-chemical Essays*, Part. I. No. II. and in the 2d and 3d part of these Essays, under the title of *Analysis of mineral Waters*.

ments which I have added of my own; and when I have found any little deviations from the truth, I have pointed them out. Every one therefore, by the repetition of these experiments with the tests contained in this collection, may immediately convince himself of the reality of the appearances attributed to them in this treatise, at the same time that he may apply the result of them to the investigation of bodies, and likewise use them as tests in any researches that he may have occasion to make. These experiments are followed by various objects of investigation, which may occur to Chemists, Physicians, Mineralogists, Metallurgists, projecting Artists, Manufacturers and Farmers; in which the tests here indicated are indispensably necessary, and where, in order to avoid unnecessary repetitions, I have constantly referred to the experiments that precede them.

Thus much indeed is allowed on all hands, that chemical investigations and analyses in the moist way, or those performed by means of menstrua and re-agents, are not the most exact, when the object is to determine the quantity of the constituent parts in any substance: but then they shew us, and that frequently with still

greater certainty than the researches in the dry way, without much loss of time or expence, and when even a small quantity only can be had of the product which is to be examined—they shew us, I say, whether that constituent part, which is supposed to be present, be really so or not, and whether it be worth while to set about investigating it more in detail, be the body liquid or solid, artificial or natural, fixed or volatile.

But for such researches, in which in many cases exact results are wanted, these tests must be as pure as possible, in order that no one, in the investigation of bodies, may be induced, by heterogeneous substances mixed with these tests, to draw false conclusions, and impute constituents parts to them, which, in fact, were never in them, till introduced by the test. Now these mistakes and defective analyses, the collection of re-agents, which I deliver ready for use in this chest, is intended in a particular manner to rectify; in the preparation of which I have been extremely careful, having examined them by every chemical principle that is yet known, and taken every method I could think of, to assure myself of their genuineness.

But any one who has been himself occupied with the preparation and purification of these tests, will certainly know the difficulties with which they are attended, and will know besides that, with all our exactness and care in the operations, still it may happen, and that frequently by mere accident, that we shall be mistaken, and that some scarcely perceptible portions of heterogeneous admixtures will still adhere to the test, which will give rise to fallacious appearances, and occasion incorrect results. For this reason I shall esteem it as a singular favour, if those who have hitherto promoted this undertaking, and may perhaps still be desirous to promote it, would submit the tests, which I here offer to the public, to a severe examination, and point out to me every appearance which may indicate a defective mode of preparation. My principal endeavour will then be, to find out the defect, amend it, if possible, and bring these tests nearer and nearer to perfection; because I am well assured, that chemical investigations and analyses in general will gain by it very much in point of certainty and exactness.

In the experiments which I have made, for

the sake of illustrating the phenomena, every thing is determined by drops and grains, this being the smallest quantity that can be applied here in the easiest manner. Any one, who wishes to know how much quicker or slower these tests operate in a larger or smaller quantity, may either increase or diminish the quantity of distilled water, or, in the first case, use a greater number of drops or grains.

Having premised thus much, I now proceed to the construction of the chest itself. It consists of two separate and neatly finished boxes, but which may be joined together in such a manner as conveniently to form one entire whole. A chest thus constructed is twelve inches long, nine inches high, and of the same breadth. The lower box, upon which the upper one is to be placed, contains fourteen phials and a glafs mortar. The phials are all made of flint glafs, and furnished with ground glass stoppers that fit them exactly; and each phial has a printed label affixed to it, expressive of its contents. In the lower box are contained:

1. Tincture of litmus.
2. Lixivium of Prussian blue.
3. Vitri-

3. Vitriolic acid.
4. Nitrous acid.
5. Marine acid.
6. Acetous acid.
7. Mild volatile alkali.
8. Mild vegetable alkali.
9. Highly rectified spirits of wine.
10. Lime-water.
11. Distilled water.
12. Calcareous liver of sulphur.
13. Crystals of tartar in powder.
14. A phial for Dr. *Hahnemann's* wine-test.

In the upper box, besides a metal blow-pipe, a small pair of scales, and a pestle for the glass mortar, are contained 21 phials with the following articles :

1. Caustic vegetable alkali.
2. Caustic volatile alkali.
3. A solution of lead in acetous acid.
4. A solution of soap.
5. A solution of arsenic.
6. A solution of corrosive sublimate in distilled water.
7. A solution of mercury in nitrous acid, prepared with the assistance of heat.
8. A solu-

8. A solution of mercury in nitrous acid,  
prepared without heat.
9. Volatile liver of sulphur.
10. Spirituous tincture of galls.
11. Ponderous earth dissolved in marine  
acid.
12. A solution of silver.
14. Purified sal ammoniac.
15. Purified Epsom salt.
16. A solution of vitriol of copper.
17. Cuprum ammoniacum.
18. Quicksilver.
19. Mineral alkali.
20. Calcined borax.
21. Fusible salt of urine.

At the side of the lower box moreover  
there is a small drawer, and in this are con-  
tained :

1. Litmus paper.
2. Brazil-wood paper.
3. Turmeric paper.
4. Litmus paper reddened with vinegar.
5. A small cylindrical glass.
6. A small glass funnel.
7. Medical weights.

Concerning the tests contained in this collection, the following particulars are to be observed.

The tincture of litmus A loses its blue colour very soon, and then becomes unfit to be used as a test; it is therefore necessary to have some genuine litmus in the collection\*, in order to be able to prepare this tincture fresh, whenever it is wanted, as this can be done without much trouble, and the tincture is besides in many cases, especially for the detection of fixed air, a more sensible test than litmus-paper.

*Tincture of Litmus. A.*

Put the litmus grossly powdered into a clean rag; pour distilled water upon it in a wine-glass or tea-cup, and let it lie in the water till it has acquired the blue colour expected from it; if the rag be only squeezed a little under the water, the tincture will be made in a few minutes.

As the lime-water H, in consequence of the

\* As this drug is not so easily procured here as in the Author's country, Mr. H. has given it a place in the collection. [E.]

phial being frequently opened, by which means the fixed air, that is usually contained in the atmospheric air, has access to it, is very apt to become turbid, depositing what is called Cream of Lime, or Mild Calcareous Earth, and can then be no longer used as a test ; and as sometimes there is more of it wanted for an experiment than is contained in the phial belonging to the collection, it may be prepared at any time and place, with very little trouble.

*Lime-Water.*

Upon three ounces of fresh-burned quicklime grossly powdered, and put into a strong glass bottle, provided with a good stopper, let a pound of moderately warm river-water be poured, by degrees, in order to prevent the bottle from cracking by the great heat that arises from the flaking of the lime. When the mixture is cold, cork the bottle well, and let it stand till it is become clear.

Although the lixivium of Prussian blue has been employed as a means of detecting iron in a liquid, yet its use remains still problematical, if, as seems to be the case, it be not possible to free it from every particle of iron that adheres

heres to it, and to bring it to such a degree of perfection, that, by the mere addition of acids, no Prussian blue will be separated from it. The most celebrated chemists, such as *Beaumé*, *Macquer*, *de Morveau*, *Scopoli*, *Gianetti*, *Scheele*, *Klaproth*, *Struve*, *Bergman*, *Westrumb*, *Fourcroy*, *Woulfe*, &c. have endeavoured to free it entirely from iron; but their attempts have proved nothing else than the impossibility of effecting this purification. I myself could relate here more than fifty experiments, which I undertook merely for the sake of purifying this lixivium; and after all the pains I have taken, I am not come a jot nearer to the point; but rather think myself authorized to assert, on the strength of these very experiments, that when the purification of this lixivium is carried so far that acids separate no more Prussian blue from it, the lixivium is then entirely ineffectual as a test for iron.

Notwithstanding this impossibility of perfectly freeing the lixivium from iron, we might still be contented, if it could only be ascertained exactly how much iron is contained in a certain quantity of it, in order that this portion might then be deducted from the whole: but this is attended

attended with almost as many difficulties as the purification itself. With respect to ascertaining this point, M. *Westrumb*\* thinks to obtain his end, by calcining about fifty grains of the crystals of phlogisticated alkali in a small porcelain crucible, washing the residuum, collecting on a small filtre the calx of iron that remains behind, edulcorating it perfectly, drying it, calcining it again for some hours, and, after having weighed it, marking on the phial, in which the phlogisticated alkali is kept, how much calx of iron is contained in a hundred parts of this salt.

Now if this mode of determination was to be depended upon, these experiments, provided they are instituted under similar circumstances, and with the same phlogisticated alkali, must necessarily always exhibit an equal quantity of calx of iron: but this is not consonant to experience, for no one experiment affords the same quantity with another. Notwithstanding all the care that can be taken, it is not possible, in the elixation, in the passing of the liquid through the filtre, and in the calcination, to prevent some particles of iron from being lost. I have like-

wise made, with as much accuracy as possible, a considerable number of experiments with crystallized and phlogisticated alkali, purified in the manner prescribed by *Westrumb*\*. I undertook the calcination in silver crucibles, in porcelain, and in others made for the purpose of pure clay, sometimes in the open fire only, sometimes under the muffle of an assaying furnace: but none of all these experiments answered exactly to the others, with regard to the quantity obtained of calx of iron. In this uncertainty I deemed it loss of time to continue these experiments any longer, and entirely gave up the idea, for the present, of the possibility of determining, by means of the lixivium of Prussian blue, the quantity of iron that is contained in a substance; especially as my intention is merely to offer to the public such tests as indicate the presence of a component part, and not the quantity of it that is present.

But yet we must retain the lixivium of Prussian blue for analyses of this kind, because it is the best means to separate the iron from

\* l. c. pag. 227.

a liquid, which, besides this substance, holds earths in solution, in order to be able to separate these earths afterwards devoid of iron. Now in order to effect this, the lixivium of Prussian blue must be entirely free from vitriolic acid, and perfectly saturated with its tinging matter; and to these qualities I have paid particular attention in the lixivium which I deliver with the chest.

As the *vegetable alkali* saturated with *faccharine acid* does not act differently from the faccharine acid itself; I have, in order to save room, omitted this salt in the chest, because I afterwards found that the hepatic-water, or *Hahnemann's Wine-test*, required three separate phials in the collection.

As the *solution of lead in nitrous* and that in *acetous acid* act exactly alike as re-agents; I have also omitted one of these solutions in the collection, and instead of it inserted Dr. *Hahnemann's Cuprum ammoniacum*.

As the *Hepatic-water*, or Dr. *Hahnemann's Wine-test*, soon loses its effect as a test, by the phial in which it is kept being frequently opened; it is necessary that it should be prepared afresh, whenever it is wanted, from the

the calcareous liver of sulphur and cream of tartar contained in the collection, and water. This test acts differently in various respects, according to the greater or smaller quantity of cream of tartar employed in its preparation: for this reason I shall here give two different prescriptions, and call one of these two compositions *Hepatic-water*, and the other the *Wine-test*.

No. I. *Hepatic-water.*

Having put sixteen grains of calcareous liver of sulphur and ten grains of cream of tartar in the phial appropriated to this liquid in the collection, fill it almost up to the top with distilled water; cork it well, shake the ingredients up together for the space of ten minutes, and let the mixture stand till it is become clear. By this liquid all metals are precipitated with a more or less dark colour; but the iron, precipitated by it of a black colour, may be redissolved by vitriolic acid.

No. II. The *Wine-test.*

Having put sixteen grains of calcareous liver of sulphur and twenty grains of cream of tartar

into the phial, fill it in like manner almost up to the top with distilled water ; the phial being well corked, shake the ingredients up together for the space of ten minutes, and let them stand to settle. This liquor precipitates all metals that are prejudicial to health ; while iron, that is perfectly harmless, is not precipitated by it.

In all the experiments, described in the following pages, perfectly pure distilled water must be employed ; it may also be requisite for the purpose of diluting perhaps a menstruum, or for edulcorating any precipitate that may have been obtained by a previous process. Now, for this purpose, there is a small quantity only contained in the collection ; as every one may prepare it himself with very little trouble, or it may be procured at the chemist's at a trifling expence.

If any of the articles, contained in this collection, should be expended, I am willing to replace them upon the most reasonable terms ; on condition, however, of being reimbursed for the expences of carriage, postage, &c.

The more or less favourable reception this  
under-

undertaking meets with from the public, will determine me whether I shall venture to lay before it another still more extensive plan, of a similar nature, though upon a somewhat larger scale. As researches in the moist way do not suffice for decomposing bodies as completely as possible, and for determining the quantity of the constituent parts that are present, but, on the contrary, we are frequently obliged besides to combine the dry mode of separation with the moist ; I intend that this first part shall be followed by a *second*, which will contain the analyses made in the *dry way*, and on occasion of which I shall present to the Lovers of Chemistry a chest, containing the whole of the apparatus requisite for the examination of bodies. Not only the analysis of the substances belonging to the mineral kingdom will be treated of here, but my plan shall extend likewise to the analysis of the *vegetable* and *animal kingdoms*; at the same time regard also shall be had to the *separation of the artificial elastic fluids*, so that the whole may be considered as a *complete chemical Laboratory in miniature*. Undoubtedly a great number of experiments are yet necessary to be made, in order to apply the ap-

paratus, in the completest and most commodious manner, to every particular case that may occur. However, as soon as every difficulty, as well with respect to this circumstance, as to providing the necessary apparatus, is overcome; I shall lay a plan of this undertaking before the friends and patrons of Chemical Science in a separate prospectus.

---

*The Appearances, that occur during the Investigation of Bodies by means of Re-agents, explained by Experiments.*

---

A. *Tincture of Litmus.*

IF a liquid be impregnated with *fixed air*, or any other acid, the blue colour of this tincture will be changed by it to *red*. But if this redness is caused by fixed air, the mixture, on being slightly warmed, will become *blue* again, because the fixed air being made to evaporate by the heat, leaves the tincture of litmus behind of its natural colour. The same result will take place, though somewhat more slowly, if the liquid is suffered to stand for some time in an open vessel. If however the redness is occasioned by any other of the more fixed acids

hitherto known, in this case the liquid, even after it is made warm, will remain red.

### Experiment I.

Into a large wine-glass \*, containing three or four ounces of pure *distilled water*, pour a few drops of the tincture of litmus, and the blue colour of this latter substance will not be altered.

### Experiment II.

Impregnate a quantity of distilled water with *fixed air*, obtained by the usual method from chalk and vitriolic acid, and to a wine-glass full of this water so impregnated add a few drops of the tincture of litmus ; its blue colour will be changed immediately to *red*. The water thus reddened, on being made warm, by placing it near the fire, or by any other convenient method, will soon recover its former *blue colour*. The result will be the same, if this reddish li-

\* Whenever a wine-glass is mentioned in the following pages, it is supposed to be of the very largest sort in use in this country, which do not exceed in size the common wine glasses of Germany. The glasses commonly used for drinking cyder or strong beer out of, may be likewise conveniently applied to this purpose. [E.]

quid is merely set by for the space of a night in an open vessel.

### Experiment III.

Having let fall into a wine-glass full of distilled water one drop of the pure *vitriolic acid*, or any of the other acids contained in the chest, add a few drops of the tincture of litmus to the mixture ; the same *red colour* will be produced, and also remain *fixed and unaltered*, even though the mixture be made warm, or stand all night in an open vessel.

### B. *Litmus-paper.*

Paper coloured with litmus is liable to undergo the same change of colour, from the action of every acid liquor, as the tincture of litmus itself; and indeed in some respects it is even preferable to the tincture, as a *test for acids* ; for, like this, it suffers no change of colour merely in consequence of the access of the fixed air, which is often contained in the atmosphere. The tincture of litmus, on the contrary, soon becomes red by the frequent opening of the phial containing it, and can no longer be used as a reagent. It is also very liable to ferment, a pro-

cess, in consequence of which the blue colour would be entirely destroyed.

#### Experiment IV.

Dip a piece of paper coloured with litmus into *pure distilled water*, and the blue colour of it will *not* be altered.

#### Experiment V.

Dip a piece of the same paper into a wine-glass full of distilled water, which has been previously impregnated with *fixed air* (Exp. II.), and in a few minutes the blue colour will be changed to *red*. Dry the paper thus reddened, by exposing it to the air, and its pristine *blue colour* will return, as fast as the fixed air flies off from it.

#### Experiment VI.

Into a wine-glass full of distilled water having let fall one drop of vitriolic, nitrous, or muriatic acid, dip into it a piece of the above-mentioned paper, and the blue colour will in like manner be instantly changed to *red*. Take out the paper, and let it dry ; the *blue* colour will *not* re-appear.

C. *Litmus-paper made red with vinegar.*

Litmus-paper made red with vinegar is a test of such *alkaline salts* and *earths*, as are held in solution in any liquid by means of fixed air; for, by a liquid of this kind, the acetous acid, with which the paper was made red, is rendered inactive, and consequently the *blue colour it exhibited at first* makes its appearance again. But, in order to know whether this change is produced in the paper by the presence of an alkaline salt or of an earth, the liquid must be evaporated in a clean vessel to one half. Now if the red colour continues still to be discharged by the evaporation of the liquor, and the blue colour to be restored, there is an alkaline salt contained in it; for that part of the fixed air which holds the earth in solution is volatilized, and the earths that have been dissolved by it are obliged to fall to the bottom, and then cease to act upon the vinegar: the alkaline salts, on the contrary, in consequence of their saline nature, remain dissolved, and in this state act alone upon the paper.

Experiment VII.

Suspend a piece of litmus-paper, made red with

with vinegar, in a wine-glass full of distilled water, and the red colour will remain *unaltered*.

### Experiment VIII.

Impregnate distilled water with fixed air, (Exp. II.) and dissolve in it a few grains of pure *calcareous earth*; let the water stand till it becomes clear, and in a wine-glass full of this clear water suspend a piece of reddened litmus-paper; the red colour will gradually disappear, and the *blue* return. Let another portion of this water be evaporated to one half, and the liquor by degrees will become turbid; because the calcareous earth, that was dissolved in it, being deprived of its menstruum, the fixed air is separated in the form of a white powder. When the white powder is deposited, and the water is become clear, suspend in it another piece of the above-mentioned paper, and the *blue colour* now will be produced *no more*.

### Experiment IX.

To a wine-glass full of distilled water add a drop or two of a solution of *aërated* or *mild vegetable alkali*, and dip a piece of the paper above-mentioned into it; immediately the *red* colour of it will

will *disappear*, and its former blue colour shew itself again. Evaporate the water, as in Exp. VIII. and examine it anew with the reddened paper ; notwithstanding this process, the *red* colour will disappear, and the blue be restored.

### Experiment X.

Let a grain of mineral alkali be dissolved in a wine-glass full of distilled water ; this solution will be seen to act upon the paper just in the same manner as the vegetable alkali did.

### D. *Paper coloured with Brazil-wood.*

Paper coloured with the tincture of Brazil-wood, by the change of its colour from *red* to *violet*, indicates the presence of an alkaline salt in any liquid : but since also, as was the case with the litmus-paper turned red by means of vinegar, the *earths combined with fixed air* produce this change of colours, it is necessary, with a view to assure one's self of the presence of an alkaline salt, for the liquid to be evaporated a little, as in C, in order to expel the fixed air, which holds the earths in solution, and to precipitate the earths, which will then be held in solution no longer. Now, if, after the evaporation, the red colour

colour of the paper is still changed by the liquid to violet, it may be confidently concluded that this water contains an alkaline salt. But here M. Hagen\* makes this necessary remark, that the gypsum likewise, which may chance to be held in solution in a liquid, is capable of producing this change of colour, which also will still happen, even if part of the liquid has been evaporated; because there will always remain a portion of the gypsum dissolved in the liquid, which is able to act upon the paper. The *paper* that is *coloured violet* by the *alkaline salt*, may yet be used as a test for *acids*; for, on the application of acids to it, the violet colour disappears, and its former red colour is produced again.

### Experiment XI.

Into a wine-glass full of *pure distilled water* dip a piece of the Brazil-wood paper, and the *red colour* of the paper will not be changed in the least.

### Experiment XII.

To a wine-glass full of distilled water add one

\* In his *Chemical Analysis of the Waters of Thuren in Prussia*. Konigsberg, 1789. (German.)

or

or two drops of a solution of *vegetable alkali saturated with fixed air*; into this solution dip a piece of the Brazil-wood paper, and the red colour of this latter will instantly be changed to *violet*.

### Experiment XIII.

One grain of *mineral alkali* dissolved in a wine-glaſs full of distilled water, produces with Brazil-wood paper the *same effect* as the vegetable alkali does. (Exp. XII.)

### Experiment XIV.

Dissolve in distilled water, impregnated with fixed air, a little pure calcareous earth, as in Exp. VIII. and let the water stand to settle. Into this clear water dip a piece of Brazil-wood paper, and the red colour will be changed by degrees to *violet*. Let another portion of the water be evaporated; the water will become turbid, the calcareous earth, which had been dissolved, will be deposited; and, if the trial be now repeated with the Brazil-wood paper, this latter will remain of a *red* hue, and no violet colour will appear.

### Experiment XV.

In a clean phial, shake up for some minutes  
a few

a few grains of pure calcareous earth, with a little distilled water and a very few drops of vitriolic acid. The vitriolic acid will dissolve the calcareous earth, and the gypsum, arising from this union, will remain dissolved in the water. If the liquor be allowed to stand till it is clear, and a piece of Brazil-wood paper be dipped in it, we shall have a confirmation of M. Hagen's observation (D); for the paper will by these means also contract a colour *inclining* to violet.

#### E. Turmeric-paper.

According to some late experiments, paper coloured with turmeric is greatly preferable to the other coloured papers, for the purpose of detecting the *alkaline salt* contained in any liquid, on account of its suffering *no* alteration from the earths combined with fixed air which may chance to be contained, together with the alkaline salt, in such liquid. If therefore there be any alkaline salt in it, the yellow colour of this paper will be changed to *brown*. The *paper* thus *changed by alkaline salts* may now also be used as a *test for acids*; as, by the action of the acids, the brown colour disappears again, and the *former yellow colour* is restored.

## Experiment XVI.

Dip a piece of turmeric-paper into a wine-glass full of pure distilled water; the yellow colour will remain *unaltered*.

## Experiment XVII.

Into the same quantity of distilled water having let fall one drop of the solution of *mild* or *aërated vegetable alkali*, in like manner dip a piece of this paper into it; after some hours the yellow colour of the paper will be found to be changed to *brown*.

## Experiment XVIII.

In the same quantity of distilled water dissolve one grain of *mineral alkali*, and dip a piece of this paper into the solution; the result will be the same as in Exp. XVII.

## Experiment XIX.

Having impregnated a small quantity of distilled water with fixed air, dissolve in it a few grains of pure *calcareous earth*. (Exp. VIII.) Now if in this solution a small slip of turmeric-paper is immersed, the colour of this latter will undergo *no alteration*. The event will be the same when

when the paper is dipped into a *solution of gypsum.* (Exp. XV.)

F. *Vitriolic acid.*

The vitriolic acid discovers, by a *slight effervescence*, the *presence of fixed air* in an uncombined state in a liquid, or the combination of this substance with *alkaline salts or earths.* If a liquid contain a *large quantity of calcareous earth* combined with fixed air, or with marine acid, and a few drops of vitriolic acid be let fall into it, and the vessel containing the mixture set by for some time, crystals of selenite will by degrees fall out of it to the bottom of the vessel. The vitriolic acid indicates also the presence of *ponderous earth*, if this latter dissolved in fixed air, or in the nitrous, muriatic or acetous acid, be present in any liquid; for, by virtue of its nearer affinity to this earth, it unites with it, and falls, as *ponderous spar*, to the bottom of such liquid, in the form of a powder of difficult solution. If the existence of nitrous acid combined with any other substance be suspected in a liquid, in order to discover this, a few drops of vitriolic acid must be added, and the liquid be made hot: then if a stopper, moistened with *volatile*

volatile alkali, be held over the heated liquid, *visible* clouds will be produced, and the nitrous acid will by this means discover itself. The *marine acid* will produce the same appearance; but as this acts quite differently towards several other re-agents to be mentioned hereafter, the presence of the latter is much sooner discoverable.

### Experiment XX.

To a wine-glaſs full of perfectly pure *distilled water* add a few drops of vitriolic acid; the mixture will take place quietly, and no *bubbles of air* will arise.

### Experiment XXI.

Impregnate distilled water very strongly with *fixed air* (Exp. II.), and to a wine-glaſs full of it add a few drops of vitriolic acid; *bubbles of air* will instantly arise, which will become more numerous on the liquor being stirred, and exhibit the appearance of a slight effervescence.

### Experiment XXII.

Having impregnated a quantity of distilled water with *fixed air*, and dissolved a few grains

of calcareous earth (Exp. VIII.) in it; add to this solution a few drops of vitriolic acid. The same appearance will now be perceived as in Exp. XXI. and if the liquid is suffered to stand at rest for the space of a night or longer, slender *crystals of selenite* will fall by degrees to the bottom of the vessel.

### Experiment XXIII.

Into a phial, together with a wine-glass full of distilled water, put a few grains of pure calcareous earth; to this add a few drops of marine or nitrous acid, and shake the whole well. A slight effervescence will ensue, and the calcareous earth will be dissolved by the marine acid. As soon as the liquor is become clear, add a few drops of vitriolic acid to it, and set it by in a quiet place; after some time genuine *crystals of selenite* will fall to the bottom; because the vitriolic acid, by virtue of its nearer affinity to the calcareous earth, combining with it, forms selenite, and the marine acid is by this means disengaged.

### Experiment XXIV.

To a wine-glass full of distilled water impregnated with a few drops of the *solution of ponderous*

*rous earth S, add one drop of vitriolic acid; white clouds will immediately arise, and after some time genuine ponderous spar will fall to the bottom of the vessel in the form of a white powder.*

### Experiment XXV.

Having dissolved a grain or two of purified nitre in a wine-glass full of water, add some drops of vitriolic acid to it, and make the liquid hot; now if a glass stopper moistened with volatile alkali be held over the surface of this liquid, very visible vapours will be seen to ascend. A grain or two of common salt dissolved in water, with a few drops of vitriolic acid added to it, will, under the same circumstances, exhibit the same phenomena.

### G. Nitrous acid.

The nitrous acid also, like the vitriolic, indicates by a *slight effervescence* the *presence of fixed air* in any liquid which is to be examined. If a liquid contains *liver of sulphur*, and a few drops of nitrous acid are added to it, a white precipitate ensues, accompanied with the usual disagreeable smell of rotten eggs. But if the liquid

be impregnated with hepatic air, no precipitate will be obtained; but the liquid, which was clear before, will lose *its transparency in some degree only*; and the fetid smell, which, when any other acid is added, is very strong, will here be *moderated*.

### Experiment XXVI.

Into a glass full of *pure distilled water*, let fall a few drops of nitrous acid, and the *result* will be the same in every respect as in Exp. XX.

### Experiment XXVII.

Impregnate, as in Exp. XXI. a small quantity of distilled water with *fixed air*, adding, instead of the vitriolic acid, a little nitrous acid to it, and the same appearances will be observed as in Exp. XXI.

### Experiment XXVIII.

Having let fall a drop of the *volatile liver of sulphur* G G, into a wine-glass full of distilled water, add one drop of nitrous acid to it; in a short time *white clouds* will be formed in the liquor, and by degrees a quantity of sulphur of the same colour, accompanied by the fetid odour above mentioned, will subside to the bottom. It

is not particularly necessary however to employ for this purpose the nitrous acid; for the vitriolic, marine, and acetous acids produce the *same* effect.

### Experiment XXIX.

Having let fall into a wine-glass full of distilled water from ten to twenty drops of *Habne-mann's Wine-test H H*, add to the mixture a few drops of nitrous acid. *No white precipitate* will ensue, and the fetid odour, which this hepatic-water had before, will be *sensibly diminished* by it.

### H. Lime-water.

Equal parts of lime-water and of any liquid, that is to be examined, being mixed together, the mixture, if any *fixed air* is contained in it in an uncombined state, will instantly become perceptibly turbid, because the caustic or pure calcareous earth, which was held in solution in the lime-water, unites at that instant with the fixed air contained in the mixture, and falls in the form of aërated calcareous earth (or chalk) to the bottom of the vessel. It is necessary to take *equal parts* of lime-water and of the liquid,

lest the calcareous earth should be redissolved by the fixed air that may chance to remain in the liquid, in like manner as some other salts of difficult solution in water; as for instance, vitriolated tartar and gypsum are readily taken up by water, when they are supersaturated with an acid:

Some chemists, as for instance, the Professors *Struve*\* and *Winterl*†, have endeavoured, by the quantity of the precipitate obtained by these means, to ascertain the quantity of the fixed air contained in a liquid. Now were a liquid to contain no other fixed air than that which is in a disengaged state, something might perhaps be determined by this method; but this being but very seldom the case, and mineral waters containing frequently, besides fixed air, an alkaline salt or magnesia combined with vitriolic or marine acid, which likewise decompose the lime-water,—this mode of ascertaining it is of course for the most part fallacious and uncertain; although M. *Struve* is of opinion that this

\* Supplement to the Chemical Annals, vol. i. No. 4, p. 98.

† *Analysis Aquar. Buddensium, Veterobudæ & Viennæ*, 1781. p. 24,

defect might be remedied by the farther examination of the precipitate.

Lime-water will also indicate the presence of corrosive sublimate in a liquid, by a *yellow or rather brick-dust coloured precipitate*; and this colour will be more perfect, if the lime-water be added boiling hot to the liquid: a similar appearance likewise is observed, when mercury dissolved in nitrous acid is contained in a liquid. Dr. *Hahnemann*\* recommends also lime-water, especially when it is used boiling hot, for detecting the presence of *arsenic* in a liquid: it yields with this a *white precipitate of difficult solution* in water, of which one part requires two thousand one hundred of cold water, to dissolve it entirely. This precipitate is soluble in the acetous acid and a solution of arsenic, and mixed up with oil, and laid on red-hot coals, yields the well-known garlic-like smell of arsenic. If *copper* be contained in a liquid, the lime-water will precipitate it of a *green colour*. The *regulus of antimony*, when combined with a liquid in the form of emetic tartar, will be precipitated of a *white colour*.

\* On the Effects of Arsenic as a Poison, the Remedies to be applied, and the Means of detecting it. Leipzig, 1786.

## Experiment XXX.

With pure *distilled water* mix a little lime-water, and the mixture will remain *perfectly* limpid and clear.

## Experiment XXXI.

Fill a two ounce phial up to the top with *fixed air*; to this add about half an ounce of lime-water, shake it well, and the lime-water will become perceptibly *turbid*. Pour this turbid water off, fill the phial anew with fixed air, put the turbid lime-water to it again, and shake it well; the liquid, which was turbid before, will immediately become *clear*; the mild calcareous earth, or chalk, that was formed, being redissolved by the redundant fixed air.

## Experiment XXXII.

Having impregnated a quantity of distilled water with *fixed air*, add a small proportion only of newly made lime-water to it; white clouds will immediately be formed, which however, on the mixture being shaken, will disappear again. But if equal parts of water impregnated with fixed air and of lime-water are

mixed

mixed together, the water will become *turbid*, and remain so.

### Experiment XXXIII.

To a wine-glass full of lime-water add one drop of the *mild* or *aërated vegetable alkali O*; the liquid will soon become turbid, and yield a white precipitate.

### Experiment XXXIV.

Dissolve a few grains either of *Epsom-salt* or *alum* in a wine-glass full of distilled water, and pour a little lime-water to the solution; it will become turbid, and a *flaky precipitate* will be gradually formed. The case will be the same with a solution of *magnesia* in the *nitrous* or *mariine* acid.

### Experiment XXXV.

Mix two or three drops of the *solution of corrosive sublimate Y*, with half a wine-glass full of distilled water; no *yellow* nor *brick-dust colour* will be produced, but the liquid will only become a little turbid, and of a whitish hue. If however twenty drops of the solution of corrosive sublimate be mixed with half a wine-glass full of distilled water, and the glass be filled up with

with lime-water, the mixture will immediately exhibit a dark yellow colour, and after some time will deposit a precipitate of the same hue. This experiment therefore shews that the solution of sublimate must be tolerably strong, in order to exhibit a *yellow*, or rather *orange colour*, with lime-water.

### Experiment XXXVI.

Upon the *solution of mercury prepared by the assistance of heat*, lime-water acts much more powerfully. To half a wine-glass full of distilled water add one or more drops of the mercurial solution U, and fill up the glass with lime-water; a yellow precipitate will immediately be formed. It is probable that in small portions of corrosive sublimate lime-water does not produce this phenomenon, on account of the muriatic acid being supersaturated; for if the experiment be repeated, by adding, before the addition of lime-water, one drop more of nitrous acid, the result of this experiment will be exactly the same as that of Exp. XXXV.

The *solution of mercury prepared in the cold*, X, acts in the same manner as corrosive sublimate, because in this, as well as in the corro-

five sublimate, there is still contained a redundant portion of acid.

### Experiment XXXVII.

If a few drops of the *solution of arsenic A A* are mixed with half a wine-glass full of distilled water, and the remainder of it is filled up with fresh lime-water, the liquid will become turbid immediately, and a white *flaky precipitate* be deposited. This phenomenon will take place still quicker, when the lime-water has been previously made boiling hot. If the liquid is poured off clear from the precipitate, and to the latter are added a few drops of acetous acid, the precipitate will be completely redissolved: the result is the same, when a few more drops of the arsenical solution are added to it. If this precipitate is separated, and, after being steeped in oil, laid upon red-hot coals, it will yield the usual garlic-like odour of arsenic.

### Experiment XXXVIII.

Into a wine-glass full of distilled water having put a few drops of a *solution of blue vitriol*, pour lime-water to the mixture, and a green precipitate will immediately take place.

Experi-

## Experiment XXXIX.

Dissolve one grain of *emetic tartar* in a wine-glass full of water, and add a little lime-water to it; a *white* precipitate will fall to the bottom, consisting of calx of antimony and tartareous felenite.

I. *Lixivium of Prussian blue.*

If a liquid holds *iron* in solution, by the intermedium of *fixed air*, or of *any other acid*, by adding a few drops of this lixivium to it, a *blue* precipitate will be formed, and fall by degrees to the bottom of the vessel. But if the iron is dissolved in *fixed air*, and the liquid is made warm, the *fixed air* (or *aërial acid*) will fly off, and the iron will fall to the bottom in the form of *ochre*. If the liquid, now become clear, after the *ochre* has subsided to the bottom, be examined afresh, there will no more *blue* precipitate be produced by the addition of a few drops of the lixivium of *Prussian blue*. But if the iron is held in solution by *any other acid*, a *blue* precipitate will still be formed on the addition of the lixivium of *Prussian blue*, even after the

the liquid has been warmed, or in part evaporated.

The several absorbent *Earths* known at present, viz. *calcareous*, *magnesian*, *aluminous* and *ponderous earth*, if they are dissolved in a liquid by the intermedium of any acid, will *not* be precipitated by the lixivium of Prussian blue, when this latter is perfectly saturated with the colouring matter, and contains no vitriolic acid. All *Metals*, on the contrary, which are held in solution in a liquid, will be precipitated by the Prussian alkali, and that mostly with *different colours*. Even *acids alone* precipitate the Prussian blue from this lixivium, however carefully it may have been purified: but if the acids are in a very dilute state, the blue precipitate does not appear immediately, but after a few days only; and this result will be accelerated by warming the liquid.

### Experiment XI.

To a wine-glass full of *distilled water* add one drop of the Prussian lixivium, and *not the least* alteration will be perceived.

## Experiment XLI.

Having impregnated a quantity of distilled water with *fixed air*, shake it up for some time with a few grains of clean *iron-filings*, and let it stand till the water is become clear. To a wine-glass full of this clear water add one drop of the Prussian lixivium; the liquid will become *blue* immediately, and after some time a *blue* precipitate will be deposited. But if a little of the same quantity of the above water be evaporated, bubbles of air will make their escape, and a yellow ochre fall to the bottom. Then if, after the water is become perfectly clear, one drop of the Prussian lixivium be added, *no blue* precipitate will be formed.

## Experiment XLII.

Shake four ounces of distilled water, a few grains of *clean iron-filings*, and one or two drops of vitriolic or marine acid together for the space of a few minutes, and let the water stand till it becomes clear; or dissolve a grain or two of martial vitriol in a little distilled water: to one half of this clear liquid add one drop of Prussian lixivium, and a *blue* precipitate will be formed.

formed immediately. If the other half be evaporated a little, and one drop of Prussian lixivium be added, a *blue* precipitate will nevertheless be seen. It is true the solution of iron may also grow turbid during the evaporation, and a little ochre will be gradually deposited; but for quite different reasons from that in Exp. XLI; a certain portion, however, of the dissolved iron will always remain behind, especially if the evaporation be not performed too slowly.

### Experiment XLIII.

Into different wine-glasses full of distilled water pour a few drops of a solution of *Magnesia* in the vitriolic, nitrous, marine or acetous acid; of a *solution of alum*; of *calcareous earth* in nitrous or marine acid; of *pondersus earth* in nitrous, marine or acetous acid:—to these several mixtures add a few drops of the Prussian lixivium, and they will *none of them* become turbid.

### Experiment XLIV.

Into different wine-glasses full of distilled water pour a few drops of a *solution of copper*, of *silver*, of *mercury*, of *zinc*, of *lead*, of *bismuth*, &c.

by

By the addition of a few drops of the Prussian lixivium, the copper will be precipitated of a *brown*, the bismuth of a *brimstone-yellow*, the mercury, silver, lead and zinc, of a *white* or *light-grey* colour.

### Experiment XLV.

Into a wine-glass full of distilled water having poured a few drops of *vitriolic*, *nitrous*, or *marine* acid, add to the mixture a few drops of the Prussian lixivium, and no alteration of colour will take place. But if the liquid has stood quiet for some days, it will gradually assume a *blueish* hue, and in the space of six or eight days, a few vestiges of a *blue precipitate* will be visible. The separation of this blue precipitate will be accelerated by slightly warming the mixture.

### K. *Spirituous tincture of galls.*

The spirituous tincture of galls indicates the presence of *iron* in a liquid, by producing a *violet colour*; whether the iron be held in solution in such liquid by fixed air or by any other acid. But if the iron be held in solution by fixed air, the liquid, upon being evaporated a little,

little, will no longer be tinged of a violet colour by this tincture; but if it be held in solution in a liquid by any other acid, the tincture of galls will still produce this colour, even though the liquid have been somewhat evaporated.

### Experiment XLVI.

To a wine-glass full of *distilled water* add one drop of the tincture of galls, and *no* alteration will be perceived.

### Experiment XLVII.

Impregnate a quantity of distilled water with *fixed air*, shake it up for some minutes with a few grains of clean *iron filings*, and let the water stand till it is become clear; fill a wine-glass with this clear water, and add to it one drop of the tincture of galls; the above-mentioned *violet colour* will instantly appear. Let another portion of this water, impregnated with iron dissolved by fixed air, evaporate in a warm place; bubbles of air will escape, a yellow ochre will fall to the bottom, and the remaining clear liquid will *no longer* be altered by the tincture of galls.

## Experiment XLVIII.

To a small quantity of distilled water add two drops of vitriolic or marine acid; and after shaking this mixture up for some minutes with a few grains of *pure iron-filings*, let the liquid stand till it is become clear.

To one half of this clear chalybeate water add one drop of the tincture of galls, upon which the *violet colour* will appear immediately. Heat the other half of the liquid till it boils, or let it evaporate a little, and examine it again by adding to it a few drops of the tincture of galls; the liquid will be still of a *violet colour*. One grain of martial vitriol dissolved in a wine-glaſs full of distilled water, will give the same results.

## L. Acid of sugar.

If *calcareous earth* dissolved by fixed air or any other acid, be contained in a liquid; a few crystals of acid of sugar thrown into it, will immediately render the *water turbid*, and a *saccharine selenite* of difficult solution will fall to the bottom. If the liquid contains but very little calcareous earth, it will not become turbid immediately,

mediately, but it must first be suffered to stand quiet for some time. Some pretend also to have observed that the acid of sugar forms a salt as difficult of solution with the earth of *magnesia*, as it does with the calcareous earth, and therefore consider the acid of sugar as an uncertain test of the presence of mere calcareous earth.

#### Experiment XLIX.

In a wine-glass full of *distilled water* dissolve a few grains of the crystallized acid of sugar, and the water will remain *perfectly clear*.

#### Experiment L.

Impregnate a small quantity of distilled water with fixed air, shake the water up for some minutes with a few grains of *pure calcareous earth*, and let the water stand till it is become clear. In one half of this water dissolve a grain of the acid of sugar; the water will *immediately* become *turbid*, and after some time a white powder (*saccharine selenite*) will fall to the bottom. Make the other half of the water hot, during which process a small quantity of chalk will be deposited by the exhalation of the fixed air; and the liquid, as soon as it is perfectly

fectly clear, will now *no longer* be rendered *turbid* by the saccharine acid.

### Experiment LI.

Shake a small quantity of distilled water, a few grains of *calcareous earth*, and a drop of nitrous or marine acid, for some minutes together, and let the liquid stand till it is become clear. Pour off a wine-glass full, and dissolve in it a few grains of saccharine acid. The water will *immediately* become *turbid*, and a white powder will be deposited at the bottom of the vessel. Having evaporated a small part of another portion of this water, examine it in like manner with the acid of sugar, and it will exhibit the *same phenomena*. This will also be the case with a liquid that contains *Selenite*. (Exp. XV.)

### Experiment LII.

Dissolve two or three grains of *Epsom salt* in a wine-glass full of distilled water, as also a few grains of the saccharine acid; the liquid will *not* become *turbid*, but even on the day following continue to be transparent. This experiment shews that the earth of magnesia does not form a salt so difficult of solution as has been imagined

imagined with the saccharine acid, and that consequently the presence of this earth is no obstacle to the detection of calcareous earth. If *ten grains or more of Epsom salt* are dissolved in the above-mentioned quantity of distilled water, and to this several grains of saccharine acid are added, neither does the liquor become turbid, even though it have stood for some days.

#### M. *Acetous acid.*

The acetous acid is, according to Dr. *Dehne's* experiments\*, an excellent means of discovering the presence of *volatile alkali* in a liquid. The outside of a glass tube is to be moistened with this acid, and held over the surface of the liquid; if by this means fumes arise on the surface of the glass tube, it is a sign of volatile alkali being present. Not only the acetous acid, but also a weak and not smoking nitrous acid, exhibits the same appearance.

#### Experiment LIII.

Hold over a glass full of pure *distilled water*

\* Supplement to the Chemical Annals, 1786. No. 2.  
pag. 32.

a stopper moistened with concentrated vinegar, and *no fumes or clouds* will be visible.

### Experiment LIV.

Into a glass full of distilled water having put a few drops of a solution of *mild* or *aërated volatile alkali*, hold a glass stopper moistened with acetous, nitrous, or marine acid over it, and *immediately clouds* will be seen to ascend.

### N. *Caustic or de-aërated fixed vegetable alkali.*

If *earth of magnesia* held in solution by fixed air be contained in any liquid, it may be discovered by means of the caustic vegetable alkali; for a *white precipitate* will be produced by it *immediately*. But, according to *M. Westrumb's* observations\*, it has no perceptible effect upon other earths contained in liquids. *M. Hagen†*, however, is not entirely of *M. Westrumb's* opinion on this point.—He allows indeed this salt to be the most perfect test of the presence of earth of magnesia, but at the same time cannot

\* In his Physico-Chemical Essays (*German*), vol. i. part ii. pag. 96.

† I. c. pag. 16.

be persuaded that *calcareous earth*, *pure aluminous earth*, and *iron* are entirely excluded from this privilege: it is upon ponderous earth only, according to him, that this salt has no effect; a position which had been already maintained before him by *Bergman*\*. The following experiments will determine this with somewhat greater accuracy.

#### Experiment LV.

To some *pure distilled water* add a few drops of the solution of caustic vegetable alkali, and the liquor will remain perfectly *transparent and clear*.

#### Experiment LVI.

Impregnate distilled water with *fixed air* (Exp. II.), dissolve in it a few grains of pure earth of *magnesia*, and let the water stand till it is become clear; to this clear liquor add a few drops of the caustic vegetable alkali, and white clouds will immediately be formed.

#### Experiment LVII.

In a wine-glass full of distilled water dissolve

\* Opusc. vol. i. pag. 99.

a few grains of *pure Epsom salt*, and add to it a few drops of the solution of caustic vegetable alkali; the liquor will *immediately become turbid*, and after some time there will be deposited a white flaky precipitate. A solution of *earth of magnesia* in nitrous or marine acid will give the same results.

### Experiment LVIII.

In a wine-glass full of distilled water dissolve one grain of *alum*; to this add one drop of the solution of caustic vegetable alkali, and the mixture will *not* be observed to become *turbid*; but if in this quantity of distilled water ten grains of alum are dissolved, a white flaky precipitate will be formed in a short time. This shews that *M. Westrumb's* observation applies only, when a very small quantity of alum is contained in a liquid: but in a somewhat larger quantity this salt certainly shews itself to operate upon the aluminous salts likewise.

### Experiment LIX.

Shake some distilled water up with a few grains of *calcareous earth*, and two drops of vitriolic, nitrous, or marine acid for some minutes,

nutes, and let the liquor stand till it is become clear. To a wine-glass full of this liquor add one drop of the solution of caustic vegetable alkali; white clouds will immediately arise, owing to the calcareous earth, which is precipitated by it; but on the liquor being stirred, these clouds disappear, for the precipitated calcareous earth is deprived of fixed air by the caustic alkali, and then remains dissolved in the liquor, just as it is in the lime water. But if this liquor be exposed to the air for some time, a thin crust of lime will appear on the surface, and the liquor itself become opake. This will take place still quicker, if the liquor be poured into a phial filled with fixed air; by this means the calcareous earth acquires fixed air afresh, and falls in the form of aërated lime or chalk (Exp. XXXI. and XXXII.) to the bottom of the vessel.

#### Experiment LX.

To a wine-glass full of distilled water add one drop of the solution of ponderous earth S, and the caustic vegetable alkali will not render the mixture turbid. But if ten drops of this solution are mixed with the same quantity of distilled

led water; upon a solution of the caustic vegetable alkali being added, white clouds will appear, and after some time the ponderous earth, which is soluble in acids without any effervescence, will subside to the bottom of the vessel.

### Experiment LXI.

Put a few grains of clean *iron-filings* into a phial, and shake them up for a few minutes with a little distilled water and *two drops of pure marine acid*. Let the water stand till it is become clear, and to a wine-glass full of it add one drop of the solution of caustic vegetable alkali; the liquid will immediately lose its transparent colour, become yellow, and after some time deposit a yellow ochre. If one grain of pure martial vitriol be dissolved in distilled water, it will give exactly the same result.

### O. *Fixed vegetable alkali saturated with fixed air.*

It is true, according to *Bergman's experiments*\*, the aërated or mild vegetable alkali precipitates all *Earths* and *Metals*, when they are held in solution in a liquid by means of an acid. But if the precipitate be easily dissolved by fixed air, the de-aërated or caustic

\* Opusc. Physic. et Chem. tom. i. pag. 99.

vegetable alkali is to be preferred ; for in this case the precipitate that is forming will frequently by means of a reciprocal or mutual affinity be redissolved in the liquid. If an *acid* be contained in a liquid, it may in like manner be discovered by the mild vegetable alkali ; for in this latter case *bubbles of air* will arise (Exp. XXI.) if this alkali be added to such liquids ; because the fixed air that is present is disengaged by this means, and escapes with effervescence. In how far this alkali will serve as a test for corrosive sublimate, see below in Exp. CIV.

### Experiment LXII.

To a wine-glass full of perfectly pure *distilled water* add a few drops of the solution of mild vegetable alkali, and *not the least* alteration will be perceived.

### Experiment LXIII.

Prepare some *selenitic-water* (Exp. XV.), or add to a wine-glass full of *spring water containing gypsum*, a few drops of this alkali, and a precipitate will immediately be formed, which, when it has subsided to the bottom, will possess all the properties of common aërated calca-

calcareous earth or chalk. The same appearance will be perceived, if pursuant to Exp. LI. the calcareous earth be dissolved in nitrous or marine acid, and a few drops of this alkali added to the liquid.

#### Experiment LXIV.

Dissolve a few grains of *alum* in a wine-glass full of distilled water, and add to it a few drops of the above-mentioned alkali; the liquor will become turbid, and throw down an aërated earth of alum.

#### Experiment LXV.

Into a wine-glass full of distilled water put a few drops of the *solution of ponderous earth*, and add to it a few drops of the solution of this alkali; the liquor will become turbid, and let fall an aërated ponderous earth.

#### Experiment LXVI.

Dissolve a few grains of the *Epsom salt* in a wine-glass full of distilled water, and add to it a few drops of the solution of the mild vegetable alkali. There will be no precipitation; or, if the liquor should grow turbid, yet on being stirred it will become clear again; and this affords an instance

instance in which magnesia, by means of the fixed air it contains, is redissolved by the liquid from which it was precipitated. But if the liquid be placed in a rather warm situation, the menstruum which is here redundant, viz. the fixed air, will evaporate, and the magnesia make its appearance in the form of a white precipitate. A solution of magnesia in nitrous or marine acid, will give the same result.

That the metallic solutions are precipitated by the aërated or mild vegetable alkali, is proved by Exp. XCI. CXII. &c.

P. *Caustic or de-aërated volatile alkali.*

Caustic volatile alkali precipitates, besides the calcareous and ponderous, all the other earths, as the earth of *magnesia*, of *alum*, and also of *iron*. According to *Westrum* it precipitates the earth of iron almost in a *metallic* state\*; he therefore recommends it particularly for the purpose of separating iron from its menstrua. Besides this, it imparts a *blue* colour to any liquid that contains copper in a state of solution.

\* *Physico-chemical Essays*, vol. i. part i. pag. 151. part ii. pag. 97.

## Experiment LXVII.

To a wine-glass full of *distilled water* add a few drops of caustic volatile alkali, and *no alteration* will be perceived.

## Experiment LXVIII.

Into a clean phial put a few grains of *calcareous earth* with distilled water, and a few drops of vitriolic, marine, or nitrous acid, and let the water stand till it is become clear; to this clear liquor add a drop or two of caustic volatile alkali, and it will not become turbid for the same reasons as in Exp. LIX.

## Experiment LXIX.

To a wine-glass full of distilled water, impregnated with a few drops of a *solution of ponderous earth*, add one drop of the above-mentioned alkali, and no precipitate will be formed: in this it coincides with calcareous earth. (Exp. LXVIII.)

## Experiment LXX.

Dissolve about a grain of *alum* in a wine-glass full of distilled water, and add one drop of this alkali

alkali to it; after some time *white flakes* will appear. The result will be the same from a few grains of *Epsom salt* dissolved in distilled water, or a solution of magnesia in nitrous or marine acid.

### Experiment LXXI.

A solution of iron made according to Exp. LXXI. and mixed with caustic volatile alkali, gives the same result as that Experiment; but that the iron is separated here *nearly in a metallic state*, I have not observed.

### Experiment LXXII.

Let fall a drop or two of the solution of *vitriol of copper* into a wine-glass full of distilled water; to this add a few drops of the caustic volatile alkali, and the liquid will immediately be tinged perceptibly *blue*.

### Q. *Mild aërated volatile alkali.*

According to *Westrumb\**, volatile alkali saturated with fixed air serves, by means of a double affinity, to separate all *Earths*, which may chance

\* l. c. pag. 97.

to be contained in a liquid. Besides, it may serve in like manner to discover the presence of *copper* in a liquid, by the blue colour it imparts to the latter.

### Experiment LXXIII.

To a wine-glass full of *distilled water* add one drop of the solution of this alkali, and *no* alteration will be perceived.

### Experiment LXXIV.

Prepare as in Exp. LXVIII. a *solution of calcareous earth*, and add to it a few drops of mild volatile alkali; *white clouds* will immediately be formed, which will disappear on the liquor being stirred, because the fixed air which is contained in it redissolves them: warm the liquid; and the fixed air, that holds the calcareous earth in solution, will fly off, and the calcareous earth will be deposited in the form of chalk or crude calcareous earth. A few drops of the solution of ponderous earth mixed with distilled water, will be affected by this alkali in the same manner.

## Experiment LXXV.

Dissolve a few grains of the *Epsom salt* in a wine-glaſs full of distilled water, and add a few drops of the volatile alkali to it; the liquor will remain perfectly clear, and no precipitate be formed; if the liquor be warmed, every thing will turn out as in Exp. LXVI. *A solution of magnesia in nitrous or marine acid* gives the same result.

## Experiment LXXVI.

Mix one or two drops of the solution of *vitriol of copper* with a wine-glaſs full of distilled water, and add a drop or two of the volatile alkali to it; a *light blue* or rather *greenish* precipitate will be formed, which, on the addition of more volatile alkali, will be redissolved with a *sapphire blue* colour.

R. *Solution of Soap.*

If liquids be impregnated with *fixed air* or any other acid, or with *earthy* or *metallic neutral salts*, soap will be decomposed by it, and a *flaky precipitate* will be formed; in earthy or metallic neutral salts, this separation takes place in virtue of a double affinity.

## Experiment LXXVII.

Mix a wine-glass full of pure *distilled water* with a drop or two of the solution of soap; and *no* alteration will be perceived.

## Experiment LXXVIII.

Having impregnated a small quantity of distilled water with *fixed air*, or a few drops of any other acid, to this water add a few drops of the solution of soap; it will immediately become turbid, and throw down a number of *white flakes*.

## Experiment LXXIX.

Having impregnated a small quantity of distilled water with fixed air, dissolve in it a few grains of *calcareous earth*, or *earth of magnesia*, and after the liquid is poured off clear from the earth that may chance to remain undissolved in it, add to it a few drops of the solution of soap; and in like manner *white flakes* will be formed in abundance, and this by means of a mutual affinity; the alkali of the soap combining with the fixed air, and the unguinous part with the earth, forming an earthy soap.

Experi-

## Experiment LXXX.

Dissolve a few grains of *Epsom salt* or *alum* in a wine-glass full of distilled water, and add to it a few drops of the solution of soap; soon afterwards the water will become turbid, and deposit a number of *white flakes* which may be explained on the same principle as Exp. LXXIX. Any of the other earths held in solution in a liquid, will give the same result; for instance, the *selenitic water* in Exp. XV. and a solution of calcareous earth, or of magnesia in nitrous or marine acid.

## Experiment LXXXI.

Mix any *metallic solution*, such as that of silver, copper, lead, iron or mercury, &c. with a wine-glass full of distilled water, and add to it a few drops of the solution of soap: this will in like manner become turbid, and a great number of white flakes will be deposited at the bottom of the vessel: the same degree of affinity operates here as in Exp. LXXIX. and LXXX.\*

\* *Brandis Commentatio de Oleorum Unguinosorum Natura.* Gottingae. 1785, § 21—32.

S. *Solution of ponderous earth in marine acid.*

This solution of ponderous earth is extremely well adapted to discover the presence of vitriolic acid either in a disengaged state or combined with *any other* substance in a liquid; because the ponderous earth is particularly disposed to forfake its menstruum, unite immediately with the vitriolic acid, and form with it a precipitate of very difficult solution; viz. *genuine ponderous spar*, Exp. XXIV. If there be too small a proportion of vitriolic acid in the mixture, it will be some time before the separation takes place; it is better therefore to let the liquid stand a little, in order to wait for the separation, or to evaporate the liquid a little, and then examine it again with the solution. Besides, as it is pretty accurately determined, that an hundred *grains* of this precipitate contain thirteen *grains* of vitriolic acid, entirely free from water, the quantity of vitriolic acid, contained in a liquid, may in some measure be discovered by this means.

Now, according to *Westrumb\**, this solution

\* 1. c. p. 100.

produces

produces a *reddish-brown* precipitate in any liquid that holds *liver of sulphur* or *hepatic air* in solution.

### Experiment LXXXII.

To a wine-glass full of *distilled water* add a few drops of the solution of ponderous earth, and *no* alteration will be perceived.

### Experiment LXXXIII.

Into a wine-glass full of distilled water let fall one drop of the *vitriolic acid F.* and to this add one drop of the solution of ponderous earth; *white clouds* will instantly be formed, and a white insoluble precipitate, which is an artificial ponderous spar, will be gradually deposited at the bottom of the vessel.

### Experiment LXXXIV.

Having dissolved a grain of the *Epsom salt D.D.* in a wine-glass full of distilled water, add to it one drop of the solution of ponderous earth, and the same appearance will be perceived as in Exp. LXXXIII. The same result will take place, if the liquid holds *Gypsum*, *Alum* or *Vitriol* in solution. If, instead of Epsom salt, two

or three grains of *Glauber's salt*, or of *vitriolated tartar*, are dissolved in distilled water, the same appearances will take place: but the remaining liquid will be of a different nature; for, instead of marine salt with basis of magnesia, it is genuine *marine salt*, or *sal digestivum Sylvii*.

### Experiment LXXXV.

Having let fall a drop of the *volatile liver of sulphur G. G.* into a wine-glass full of distilled water, add to it one drop likewise of the solution of ponderous earth; the liquor will become turbid, and after some time will deposit, not a *reddish brown*, but a *whitish grey* precipitate.

### Experiment LXXXVI.

Into a wine-glass full of distilled water let fall ten drops of *Hahnemann's wine-test*; upon adding to it one drop of the solution of ponderous earth, a precipitate similar to that mentioned in Exp. LXXXIV. will fall to the bottom of the vessel.

### T. *Solution of silver in nitrous acid.*

The solution of silver in nitrous acid is an excellent test of the *vitriolic* and *marine acids*.

But

But as the alkaline salts and earths likewise precipitate silver from its solution, the alkaline salts and earths, which may chance to be contained in such a liquid, are to be previously saturated with a few drops of the pure nitrous acid. Now if a liquid contains *vitriolic acid*, or any *salt appertaining to that genus*, there will be formed, according to *Westrumb*\*, a *white crystalline powder*, that is soluble in nine hundred parts of water: but if the liquid contains *marine acid*, or *any of the salts into the composition of which this acid enters*, a *white flaky precipitate* will be formed, that is soluble in the nitrous and acetous acid. These acids however, or their respective salts, seldom occurring alone in a liquid, but for the most part mixed with others; the precipitates produced by them are commonly mixed likewise, and the difference between them is difficult to be determined.

According to *Westrumb*†, a *black precipitate* also will be produced by the solution of silver, if the liquid contains *liver of sulphur* or *hepatic air*. This chemist has likewise observed, that

\* l. c. p. 101.

† l. c. p. 101.

the solution of silver is capable of producing a dark colour in consequence of the action of *extractive matter* upon it—the air of *marshes* and *inflammable vapours*. And farther, when the vitriolic and marine acid have been previously separated by the solution of ponderous earth and of lead, the quantity of *mucilaginous matter* also existing in a liquid may be discovered by means of the solution of silver; for when a liquid contains this substance, a few drops of the solution afford a precipitate, three grains of which contain two grains of mucilaginous matter.

#### Experiment LXXXVII.

To a wine-glass full of *distilled water* add one drop of the solution of silver, and no alteration will take place.

#### Experiment LXXXVIII.

If a few drops of *vitriolic acid* are mixed with a wine-glass full of distilled water, and a few drops of the solution of silver added to it, in like manner there will be no precipitate produced, but the mixture will be rather of an opal

opal hue. After some time the water will acquire a reddish cast, and in the space of a few days a precipitate of this colour will be deposited.

### Experiment LXXXIX.

Let fall a drop of pure *marine acid* into a wine-glass full of distilled water, and to this add one drop of the solution of silver; a *white precipitate* will immediately be produced, which some time after will acquire a blueish appearance; but the precipitate will not be redissolved by the addition either of nitrous or of acetous acid.

### Experiment XC.

Take two wine-glasses full of distilled water; in the one dissolve a grain of *Epsom salt*, *Glau-ber's salt*, or *vitriolated tartar*; in the other a grain of *common salt*, *sal ammoniac*, *calx salita*, or *magnesia salita*; and the appearances which are perceptible here, will be perfectly similar to those of Exp. LXXXVIII. and LXXXIX. A selenitic water (Exp. XV.) or one grain of alum dissolved in distilled water, will give just the same result as Exp. LXXXVIII.

Experi-

## Experiment XCI.

Let a few drops of the solution of the *mild vegetable alkali* O. fall into a wine-glass full of distilled water, and to this add a few drops of the solution of silver; a white precipitate will immediately be produced. Again, mix a few drops of the alkaline solution with another wine-glass full of distilled water, but add so much of the nitrous acid G. to it, till the alkaline salt is perfectly saturated with it; now if into this liquor a few drops are put of the solution of silver, it will not be observed to become turbid.

## Experiment XCII.

Having impregnated a small quantity of distilled water with fixed air, dissolve a few grains of *calcareous earth* in it, and let the water stand till it is become clear. To one half of this transparent liquid add one drop of the solution of silver; the liquid will be tinged of a *reddish* hue, and after some time a precipitate of the same colour will subside to the bottom of the vessel. The calcareous earth, that is contained in the other half of the transparent liquid, satu-

rate with the pure nitrous acid; and now add a few drops again of the solution of silver, and, as in Exp. XCI. the liquid will *not* become *turbid*. The observation therefore of *Bergman\** and *Weßtrumb†*, according to which even earths combined with fixed air decompose the solution of silver, is confirmed by this experiment.

### Experiment XCIII.

Into a wine-glass full of distilled water having let fall one drop of the *volatile liver of sulphur* G. G. add to this a drop of the solution of silver; *clouds of a light-brown colour* will immediately be formed, and after some time a precipitate of the same hue will be deposited at the bottom of the vessel. The result will be the same also with the ordinary liver of sulphur.

### Experiment XCIV.

Into a wine-glass full of distilled water having let fall ten drops of *Hahnemann's wine-test* H. H. add to it one drop of the solution of silver, the liquid will not become *brown* quite so soon

\* Opusc. Physic. et Chem. vol. i. p. 102.

† l. c. part ii. p. 101.

as in Exp. XCIII. ; but after some time a visibly brown precipitate will appear.

**U. Solution of mercury or quicksilver in nitrous acid, prepared with the assistance of heat.**

If a liquid contains marine acid, or neutral, earthy or metallic salts, composed of the marine acid, by the addition of this mercurial solution a white precipitate will be produced in abundance. In like manner the vitriolic acid, or its neutral, earthy or metallic salts, when they happen to be present, yield with this solution a white precipitate, which however will become yellow in boiling hot water. If mild vegetable alkali be present in a liquid, this mercurial solution produces with it a precipitate of a yellowish white colour. But in order that the aërated earths, which may happen to be contained at the same time in a liquid, may not act upon the mercurial solution, a few drops of pure nitrous acid are previously to be mixed with it. If such liquid contains liver of sulphur or hepatic air, the mercurial solution indicates this also by a brownish-coloured precipitate. If iron united with vitriolic acid be present, a brimstone-coloured precipitate is immediately formed.

## Experiment XCV.

To a wine-glass full of *distilled water* add one drop of the mercurial solution, and *no* alteration will be perceived. But if the distilled water is impregnated with *mucilaginous particles*, small white clouds are produced in consequence of this solution being added; a circumstance which *Bergman\** observed, when he had dissolved three grains of cherry-tree gum in three quarts of *distilled water*.

## Experiment XCVI.

Having let fall a drop of *marine acid* into a wine-glass full of distilled water, and added one drop of this mercurial solution, *white clouds* will immediately appear, and a precipitate of the same colour will subside to the bottom of the vessel. The result will be the same, when *marine* or *common salt*, or any earthy combination with the *marine acid*, is employed.

## Experiment XCVII.

Into a wine-glass full of distilled water having let fall one drop of *vitriolic acid*, add to this

\* Opusc. vol. i. p. 103.

one drop of the mercurial solution; *yellowish clouds* will immediately be formed in the liquor, and by degrees a precipitate of the same colour will be deposited. The clear part of the liquor being poured off, the yellow hue will, by the addition of fresh warm water, be still perceptibly heightened. The same appearance will be perceived, if a grain or two of *Epsom salt*, or any *vitriolic, neutral, earthy or metallic salt*, as for instance, *Glauber's salt*, *vitriolated tartar*, *alum*, *selenite*, (Exp. XV.) are dissolved in the same quantity of distilled water, and one drop of the solution of quicksilver is added to the mixture.

### Experiment XCVIII.

Into a wine-glass full of distilled water having let fall one drop of the *mild vegetable alkali* O. to this add a few drops of the *solution of quicksilver*; clouds of a *yellowish white colour* will instantly be produced, and the mixture, if set by, will deposit a precipitate of the same colour. If in the above-mentioned quantity of distilled water a grain of *mineral alkali* is dissolved, on the addition of this solution, the same appearances will be perceived.

## Experiment XCIX.

Into a wine-glass full of distilled water having let fall a drop or two of the *volatile liver of Sulphur* G. G. to this add one drop of the solution of quicksilver; clouds of a *darkish yellow colour* will be produced, and likewise after some time a precipitate of the same hue will be deposited at the bottom of the vessel.

## Experiment C.

If a few drops of *Hahnemann's wine-test* H. H. are mixed with a wine-glass full of distilled water, and to this one drop of the solution of quicksilver is added, *clouds of a dirty yellow hue inclining to brown* will in like manner appear, and after some time a precipitate of the same colour will be deposited at the bottom of the vessel.

## Experiment CI.

Into a wine-glass full of distilled water let fall a drop or two of vitriolic acid, and shake this mixture up for the space of some minutes with a few grains of *clean iron filings*; or dissolve a grain of pure martial vitriol in a wine-glass.

glass full of distilled water; the water having stood till it is become clear, add to it a drop of the solution of quicksilver, and in a short time a *beautiful yellow* precipitate will be obtained, which, in my opinion, is nothing but a vitriol of mercury, or *Turpeth mineral*, as the greatest part at least of the dissolved iron is still to be found in the remaining liquid; for after the yellow precipitate in this experiment has perfectly subsided, a few drops of the tincture of galls, added to the liquid remaining upon the precipitate, indicate, by the violet colour they impart to it, that iron is yet contained in it: and this the following experiment with the marine acid seems still more to confirm; for though no vitriol of mercury is formed here, yet some particles of the iron that is contained in the mixture may in like manner give the precipitate a yellowish tinge.

### Experiment CII.

Having mixed a few drops of a saturated solution of *iron in marine acid*, with a wine-glass full of distilled water, add to it a few drops of this solution of quicksilver; a precipitate will soon appear, and the clear liquid being poured off,

off, and a few drops of the tincture of galls added to it, it will in like manner be found that the iron is still present in the liquid, and has no share in the precipitate that has been formed.

#### X. *Solution of quicksilver prepared without heat.*

This solution of quicksilver does not hold so much quicksilver in solution as the other, and, according to *Bergman*\*, the quicksilver has lost less of its phlogiston, than it would if the solution had been made by heat. Now it is on this account that this solution reacts somewhat differently from the other: this difference is principally seen in the different effects of the solution upon the *mild* and *caustic vegetable alkalies*; for here much brighter colours are produced than by that solution which was prepared with heat. But in most cases the effect is the same with that prepared by heat, which will be seen if the Experiments from XCV. to CII. are repeated with this solution, and the quantity of the added solution is at the same time somewhat increased. How the solutions

\* Opusc. Phys. et Chem. vol. i. p. 102,

of quicksilver U. and X. act upon lime-water, see in Experiment XXXVI.

### Y. *Solution of corrosive sublimate.*

Liquids containing vegetable alkali united with fixed air produce with the solution of corrosive sublimate an orange-coloured precipitate. *Calcareous earth combined with fixed air* shews itself, according to *Westrumb*\*, by a white precipitate. He has also observed, that when a liquid contains *liver of sulphur*, or *hepatic-air*, it produces with the solution of corrosive sublimate, in the first instance a *black*, and in the second a *white* precipitate.

### Experiment CIII.

To a wine-glass full of pure *distilled water* add a few drops of the solution of corrosive sublimate, and *no* alteration will be perceived.

### Experiment CIV.

Let fall one drop of the solution of mild vegetable alkali O. into a wine-glass full of distilled water, and add to it one drop of the solu-

\* I. c. p. 105.

tion of corrosive sublimate; after some time the liquid will become turbid, and deposit a *white precipitate*: The same appearance will be perceived, if with a glass full of this mercurial water two, three, four, five, six, seven or eight drops of the alkali are mixed; upon nine drops being added, several yellow clouds are formed, and ten drops produce the *orange-coloured precipitate* in full perfection.

### Experiment CV.

One grain of *mineral alkali* being dissolved in a wine-glass full of distilled water, and one drop of the solution of corrosive sublimate added to it, a *white precipitate* is produced; five grains dissolved in the same quantity of water, yield an *orange-coloured precipitate*, as in Exp. CIV.

### Experiment CVI.

Into a wine-glass full of distilled water let fall one drop of *volatile liver of sulphur* G. G. and to this add one drop of the solution of corrosive sublimate; clouds of a *whitish yellow colour* will immediately be formed, which grow darker and darker, and after some time a *red-*

*dish-brown precipitate* will be deposited at the bottom of the vessel.

### Experiment CVII.

Mix ten drops of *Hahnemann's wine-test H. H.* with a wine-glass full of distilled water, and to this mixture add a few drops of the solution of corrosive sublimate; a *precipitate of a dark yellow colour inclining to brown* will be formed, similar to that of Exp. CV.

### Experiment CVIII.

In order to know if the solution of corrosive sublimate will likewise produce a *white precipitate* with *earths dissolved in fixed air*, impregnate a little distilled water with fixed air, and in this menstruum dissolve a few grains of calcareous earth. Let the water stand till it is become clear; and to a wine-glass full of this transparent fluid add a few drops of the solution of corrosive sublimate, and *no white precipitate* will appear. The aërated calcareous earth therefore does *not* act upon the solution of corrosive sublimate. Aërated magnesia dissolved in distilled water is in the same predicament; but if the water is strongly saturated with calcareous

earth or magnesia, a precipitate may be produced, on warming the liquid, as by this means the menstruum, *viz.* the fixed air, is volatilized. How the solution of corrosive sublimate acts with respect to lime water, see in Exp. XXXV

Z. *Solution of sugar of lead in distilled water.*

By this vegeto-saturnine solution the presence of *vitriolic* or *marine* acid, or of the *neutral salts* composed of them, is discovered by a *white precipitate*, of which that precipitate, which is produced by the marine acid, is soluble in vinegar; that produced by the vitriolic acid, on the contrary, is not. But to prevent the alkaline salts and earths combined with fixed air, which may happen to be contained in a liquid, from acting here as precipitants, add previously to the liquid a few drops of nitrous acid, in order to saturate them and render them inactive. A liquid containing *liver of sulphur*, or *hepatic air*, yields with the solution of sugar of lead a more or less *dark-coloured* precipitate.

Experiment CIX.

To a wine-glass full of *distilled water* add one

drop of the vegeto-saturnine solution, and no alteration will take place.

### Experiment CX.

Into a wine-glass full of distilled water let fall one drop of *vitriolic acid*; to this add one drop of the solution above-mentioned, and a *white precipitate* will immediately be formed. Prepare a selenitic-water, as in Exp. XV. or dissolve a grain of *pure Epsom salt, alum, or any other neutral vitriolic salt*, such as *Glauber's salt, vitriolated tartar, &c.* in the above quantity of distilled water; add one drop of the solution of sugar of lead to it, and the result will be the same in every respect as with the vitriolic acid. *A hundred grains of vitriol of lead contain, according to Bergman\**, twenty-eight grains of vitriolic acid.

### Experiment CXI.

The solution of sugar of lead is not so well adapted for discovering a *small portion of marine acid*, or of the *neutral salts composed of it*, as it is for detecting vitriolic acid. If one drop of ma-

\* Opusc. vol. i. p. 104.

rine acid be let fall into a wine-glass full of distilled water, and one drop of the solution of sugar of lead added to it, no alteration will be perceived; and five drops of the acid being mixed with the above-mentioned quantity of water, the result will be the same; neither will any alteration be seen on the addition of ten, twenty, thirty, forty and even fifty, drops. But sixty drops of marine acid being mixed with a wine-glass full of distilled water, and a little of the solution of sugar of lead added to it, will render the liquor turbid, and small crystals will be gradually deposited at the bottom of the vessel, which are neither soluble in the acetous nor in the nitrous acid. The appearances produced by common salt and the different combinations of the earths with the marine acid and the solution of sugar of lead, are not very different from those produced by the marine acid. After collecting the precipitate together, and drying it, pour a little diluted acetous acid upon it, and it will be dissolved.

### Experiment CXII.

Having let fall a drop or two of the *mild vegetable alkali* O. into a wine-glass full of dis-

tilled water, add to it a few drops of the solution of sugar of lead, and a copious *white* precipitate will immediately be formed. To another wine-glass full of distilled water add a drop or two of the alkali, and pour on it so much of the *nitrous acid* G. till the alkali contained in the mixture is saturated with it; on the addition of the *vegeto-saturnine* solution, *no* precipitate will now appear; and even if a white cloud or two should be perceived, they will be redissolved upon the liquor being stirred. The *aerated* calcareous earth and magnesia, when present in a liquid, produce the same appearances.

### Experiment CXIII.

Having impregnated a wine-glass full of distilled water with one drop of the *volatile liver of sulphur* G. G. add to it a drop of the *vegeto-saturnine* solution; clouds of a *dark-brown colour* will immediately appear, and a precipitate of the same colour will be deposited at the bottom of the vessel.

### Experiment CXIV.

Ten drops of *Hahnemann's wine-test* H. H. mixed

mixed with a wine-glass full of distilled water, exhibits, with the addition of one drop of the vegeto-saturnine solution, the same appearance as Exp. CXIII.

A. A. *Solution of arsenic in distilled water.*

The solution of arsenic is excellently well adapted for discovering the presence of liver of sulphur, or hepatic-air, in a liquid. If therefore to a liquid, containing liver of sulphur or hepatic-air, a little of this solution of arsenic is added, a more or less *yellow* colour will be produced; and if there be much sulphur in the mixture, a *yellow precipitate* will be deposited.

Experiment CXV.

Let fall a few drops of the solution of arsenic into a wine-glass full of pure *distilled water*, and no alteration will be perceived.

Experiment CXVI.

Having let fall one drop of the *volatile liver of sulphur* G. G. into a wine-glass full of distilled water, to this mixture add a few drops of the solution of arsenic; the liquid will immediately become turbid, *yellow clouds* will be produced,

duced, and after some time a precipitate of the same colour (viz. Orpiment) will subside to the bottom of the vessel.

### Experiment CXVII.

Let fall ten drops of *Hahnemann's wine-test* H. H. into a wine-glass full of distilled water, and to this add a few drops of the solution of arsenic: at first the lower part of the liquor will be coloured *yellow*; but on being stirred, the whole will acquire the same colour, and after some time a yellow precipitate likewise will be deposited, just as in Exp. CXVI.

### B. B. *Mercury, or Quicksilver.*

According to *Westrumb's*\* experiments, quicksilver also is an excellent test for discovering the presence of *sulphur* in a liquid. A little quicksilver, that is pure and entirely free from dust on its surface, is to be put into the liquid, which must be suffered to stand quiet for several hours. Now if the liquid contains sulphur combined in any manner whatsoever, the mercury will lose its metallic *splendor*,

\* I. c. p. 107.

will become more or less *refractory and solid*, and more or less of a *red or black* colour,

### Experiment CXVIII.

Into a clean phial filled with distilled water put a little mercury, and let it stand for some time; the mercury will retain the whole of its metallic splendor.

### Experiment CXIX.

Into a clean phial that holds three ounces of water, put one drop of the *volatile liver of sulphur* G. G. with three ounces of distilled water, and throw into the mixture a little bright and perfectly pure mercury; in a short time the mercury will lose its splendor, and its surface will be covered with a *brown or black* pellicle.

### Experiment CXX.

In like manner mix ten drops of *Hahnemann's wine-teft* with four ounces of distilled water, and put to the mixture a little pure quicksilver; the result will be in every respect the same as in Exp. CXIX.

C. C. *Pure Epsom salt.*

As the earths, that are held in solution in a liquid by means of fixed air, are not decomposed by pure Epsom salt, this latter has been recommended as a test for discovering the *alkaline salts* which may chance to be contained in a liquid, because the pure Epsom salt is decomposed by the alkali, and the magnesia is separated: but when the portion of alkaline salt contained in a liquid is but small, this test cannot well be applied; as, for a precipitate to be formed here, the alkali must be in a caustic state, and in this state it is perhaps very seldom to be met with in any liquid that is to be examined. But if it be combined with fixed air, the earth of magnesia, by virtue of a double affinity, unites with this latter, and then remains by its means, as in Exp. LXVI. dissolved in the liquid. When however this test is applied, it is necessary to heat the liquor, by which means the fixed air is volatilized, and the magnesia separated.

## Experiment CXXI.

In a wine-glaſs full of pure distilled water dissolve a few grains of pure Epsom salt, and *no* alteration will be perceived.

Experi-

## Experiment CXXII.

Into a wine-glass full of distilled water let fall a drop or two of *mild* or *aërated vegetable alkali*; or dissolve in this quantity of water a few grains of *mineral alkali*, and add to the mixture a few grains of the pure Epsom salt; the Epsom salt will dissolve, and no precipitate will be perceived. But heat the mixture with a very gentle heat, and immediately *white flakes* will be separated, which will dissolve in any acid that is added to them, with effervescence, on account of the fixed air remaining combined with them. But if the *caustic alkali N.* is mixed with distilled water, and a few grains of pure Epsom salt are afterwards dissolved in this same water, a precipitate appears immediately, which is also soluble in acids, but without effervescence, on account of the precipitated magnesia being deprived of its fixed air. See Exp. LVII.

D. D. *Sal ammoniac.*

According to some well-known experiments, sal ammoniac discovers the *alkaline particles* contained in a liquid in two different ways: *in the first place, by the augmentation of cold*, which it

it produces in a liquid when there is an alkaline salt in this latter, and which must be determined by a sensible thermometer; and *secondly*, by the *extrication of the volatile alkali*, which, by means of the fixed alkali contained in the liquid, is, in consequence of the nearer affinity of the fixed alkali to the marine acid, separated and set at liberty; and this latter proof, especially if the quantity of the fixed alkali be but small, is to be preferred in every respect to the first.

### Experiment CXXIII.

Having dissolved a few grains of pure sal ammoniac in a wine-glass full of *pure distilled water*, hold a stopper moistened with acetous acid over the liquor; and *no vapour* will be seen to ascend.

### Experiment CXXIV.

Into a wine-glass full of distilled water let fall one drop of the solution of *mild vegetable alkali* O. or dissolve in this quantity of distilled water two grains of *mineral alkali*, and to the solution add a few grains of sal ammoniac: over the surface of this liquid hold a stopper with nitrous, marine or acetous acid, not in a fuming

fuming state; and the ascent of a *rare vapour* or *cloud* will indicate the separation of the volatile alkali, by means of the fixed alkali that was contained in the mixture: this appearance will be perceived still more distinctly, if the liquid be warmed a little. With this compare Exp. LIV.

E. E. *Solution of vitriol of copper.*

Alkaline salts contained in a liquid may be discovered by means of the solution of blue vitriol. The earths also that are held in solution in liquids by means of an acid, will be rendered visible by this means. The vegetable alkali manifests itself by a *dark sea-green* colour; the mineral alkali by a *bright apple-green*; magnesia produces with it a *dark apple-green*; calcareous earth, a *yellowish green*; and earth of alum, a colour similar to that of *verdegris*. But these appearances are not to be trusted to; as, with respect to the different shades of colours it produces, a mistake may easily be committed\*. If arsenic be contained in a liquid, a *yellowish green colour* (*Scheele's green*) is produced by the addition of

\* *Westrumb*, l. c. p. 98.

this solution. The presence of sulphur also, or of liver of sulphur, in a liquid may be inferred, if by this means a *blackish brown colour* is produced.

### Experiment CXXV.

To a wine-glass full of *distilled water* add one drop of the solution of blue vitriol, and *no alteration* will be perceived.

### Experiment CXXVI.

Into a wine-glass full of *distilled water* let fall a drop or two of the solution of *vegetable alkali O.* or dissolve two grains of *mineral alkali* in the above-mentioned quantity of this water, and add to the mixture a few drops of the solution of vitriol of copper; *green clouds* will immediately be formed, and after some time a precipitate of the same colour will be deposited at the bottom of the vessel.

### Experiment CXXVII.

A few drops of the solution of *mild volatile alkali Q.* being mixed with pure distilled water, and a few drops of this vitriolic solution added to it, a *green precipitate* is produced, which, with regard

regard to colour, is not very different from that of Exp. CXXVI; but if more of the volatile alkaline solution be added to it, the former green precipitate will be entirely dissolved, and this liquid will acquire as in Exp. LXXII. a fine *sapphire blue* colour.

### Experiment CXXVIII.

In a wine-glass full of distilled water dissolve a grain of the *pure Epsom salt* C. C. and add to it a few drops of the solution of blue vitriol; soon after, clouds of a *pale green colour* will appear, and after some time a precipitate likewise of the same hue will be deposited at the bottom of the vessel. A solution of magnesia in nitrous or marine acid will give the same result.

### Experiment CXXIX.

Prepare a selenitic water (Exp. XV.), or a solution of *calcareous earth in nitrous or marine acid* (Exp. LI.), and add to it a few drops of this vitriolic solution; *clouds of a pale green colour* will in like manner be formed, but verging more to yellow than those mentioned in Exp. CXXVIII.

## Experiment CXXX.

Dissolve a grain or two of alum in a wine-glass full of distilled water, and add to the solution a few drops of the solution of blue vitriol; a green precipitate will be formed with a small tinge of blue in it; but the blue cast of this precipitate may proceed from the alum being seldom entirely free from volatile alkali.

## Experiment CXXXI.

Let fall a few drops of the *solution of arsenic A. A.* into a wine-glass full of distilled water, and to this add a few drops of the solution of vitriol of copper; clouds of a *yellowish green colour* will appear, and after some time a similar precipitate (*Scheele's green*) will be deposited at the bottom of the vessel.

## Experiment CXXXII.

Into a wine-glass full of distilled water let fall a drop or two of *volatile liver of sulphur G. G.* and add to it a few drops of the solution of vitriol of copper; clouds of a *blackish brown hue* will immediately be formed, and after some time

time a precipitate of the same colour will fall to the bottom.

### Experiment CXXXIII.

Ten drops of *Hahnemann's wine-test* H. H. mixed with a wine-glaſs full of distilled water, to which a few drops of the solution of vitriol of copper are added, produce a *blackish brown* precipitate, perfectly similar to that of the preceding Experiment.

### F. F. *Cuprum ammoniacum.*

The *Cuprum ammoniacum* is recommended by Dr. *Hahnemann*\* as an excellent means of discovering arsenic in a liquid; for it produces with it a *yellowish green* precipitate (*Scheele's green*), which, if separated from the superincumbent liquor, dried, and put upon ignited coals, manifests itself by the garlic-like smell peculiar to arsenic. This precipitate is not soluble in water alone, nor in the solution of arsenic, but in caustic volatile alkali and in acids†.

### Experiment CXXXIV.

To a wine-glaſs full of pure distilled water add

\* l. c. p. 239.

† l. c. p. 238.

one drop of the solution of cuprum ammoniacum ; the water will acquire a *blue colour*, but it will not become turbid, nor will any precipitate be formed.

### Experiment CXXXV.

Into a wine-glass full of distilled water let fall a drop or two of *the solution of arsenic A. A.* and add to it a few drops of the solution of cuprum ammoniacum ; a yellowish green precipitate will immediately ensue, which, if collected, dried, and put upon ignited coals, diffuses around a smell of garlic. According to *Hahnemann\**, two hundred and sixty-seven grains of this precipitate contain one hundred and sixty-two grains of copper, and one hundred and sixty-five grains of arsenic. Divide the whole of the liquid, together with the yellowish green precipitate, into four parts, and add to one a little distilled water only ; to the second, a little of the arsenical solution ; to the third, a little caustic volatile alkali ; and to the fourth, a few drops of vinegar, or of any other acid contained in the collection. On the addition of water only, *no*

alteration will be perceived, any more than from the arsenical solution; but the caustic alkali will immediately dissolve the precipitate, and exhibit a perfectly transparent liquid, of a sapphire blue colour; and the acid added to the fourth part will in like manner dissolve the precipitate.

G. G. *Volatile liver of sulphur.*

By means of the volatile liver of sulphur any acid contained in an uncombined state in a liquid may be discovered; for, on the addition of a few drops of this liver of sulphur, a *white precipitate of sulphur* will be produced. If arsenic be held in solution in a liquid, it will be manifested by the *yellow*, or, if it contains much arsenic, *red* colour of the liquid, and by the appearance of a precipitate of the same hue. If a liquid holds regulus of antimony in solution, it will be precipitated by this solution, of an *orange colour*, in the form of *golden sulphur of antimony*, or *Kermes* mineral. But besides, according to *Westrumb*\*, by this liver of sulphur there is produced, with liquids that hold *iron* or *copper* in solution, a *black*, and with such as contain *ponderous earth*, a *brown* colour.

\* l. c. p. 238.

## Experiment CXXXVI.

To a wine-glaſs full of pure *distilled water* add a few drops of volatile liver of sulphur, and the mixture will *not* become *turbid*.

## Experiment CXXXVII.

Into a wine-glaſs full of distilled water let fall a drop or two of *any acid*; and if a few drops of this liver of sulphur are added to it, a white precipitate of sulphur (Exp. XXVIII.) will be instantly formed.

## Experiment CXXXVIII.

Into a wine-glaſs full of distilled water let fall a few drops of the *solution of arsenic A. A.* Upon adding a few drops of the volatile liver of sulphur to it, the same appearance will be perceived as in Exp. CXVI.

## Experiment CXXXIX.

Dissolve a grain of *emetic tartar* in a wine-glaſs full of distilled water, and add to it a few drops of the liver of sulphur above mentioned; an *orange colour* will immediately appear in the liquor, and a precipitate of the same hue will be deposited, which upon nearer examination will

will be found to be a *golden sulphur of antimony*, or *Kermes mineral*. A similar precipitate will appear, if to a few drops of *butter of antimony* a drop or two is added of the volatile liver of sulphur diluted with distilled water.

### Experiment CXL.

Prepare as in Experiment XLII. a *vitriolic chalybeate water*, or else dissolve one grain of *vitriol of iron* in a wine-glass full of distilled water. To this chalybeate water, which is perfectly transparent, add a few drops of the volatile liver of sulphur, and a *black* precipitate will immediately appear; if to this black precipitate a few drops are added of the vitriolic acid F. it will be perfectly *redissolved*, and the black colour will entirely *disappear*.

### Experiment CXLI.

Into a wine-glass full of distilled water let fall a few drops of the solution of *vitriol of copper*, and to the mixture add a few drops of this liver of sulphur; the result will be the same in every respect as in Experiment CXXXII. If to this precipitate of copper a few drops of vitriolic acid are added, it will not disappear as in

Experiment CXL, but remain unaltered. For the action of the volatile liver of sulphur upon *ponderous earth, silver, mercury, and lead*, when any of them are held in solution in a liquid, see the Experiments LXXXV. XCIII. XCIX. CVI. and CXIII. None of these precipitates are capable of being redissolved by the addition of vitriolic acid.

H. H. *Hahnemann's wine-test, or Water impregnated with hepatic air.*

This hepatic-air water, which for experiments ought always to be prepared fresh from the calcareous liver of sulphur and cream of tartar contained in the collection, according to the receipt No. I. or No. II. given in the introduction, differs from the volatile liver of sulphur, in *not* rendering *turbid*, liquids that contain uncombined acids. According to Dr. *Hahnemann*\* it is an excellent means of discovering *arsenic* that is held in solution in a liquid, by the yellow colour that takes place on this occasion. The production of this colour is accelerated by acids, and prevented by alkaline

\* I. c. p. 246.

salts. *Iron* is precipitated perfectly black by it; and the precipitate is, as in the case of the volatile liver of sulphur, *redissolved* by vitriolic acid. Upon *lead*, *copper*, and *most* other metals, this hepatic-air water acts like the volatile liver of sulphur: none of these metallic precipitates are soluble again in vitriolic acid. The solution of *regulus of antimony* is precipitated by it of an *orange colour*, in the same manner as by the volatile liver of sulphur.

#### Experiment CXLII.

To a wine-glass full of pure *distilled water* add a few drops of hepatic-air water, and *no* alteration will be perceived.

#### Experiment CXLIII.

Into a wine-glass full of distilled water having let fall a few drops of any of the *acids* contained in the collection, to this add a few drops of the wine-test; and the mixture, just as in Experiment XXIX. will *not* be perceptibly turbid.

#### Experiment CXLIV.

Into a wine-glass full of distilled water let fall a few drops of the *solution of arsenic A. A.* and

and add to it a little of the hepatic-air water; soon after this addition the liquor will acquire a *golden* colour, and after some time a precipitate of the same hue (viz. orpiment) will be deposited at the bottom of the vessel. The production of this yellow colour is *accelerated* by adding a few drops of the acetous acid M. but on the addition of a few drops of the alkaline solution O. the *yellow colour* will *entirely disappear*. If this yellow precipitate be dried, and thrown upon red-hot coals, at first a *smell of sulphur* will be perceived, and afterwards of *arsenic*.

### Experiment CXLV.

To a little of the *chalybeate* water prepared according to Exp. CXL. or to a wine-glass full of distilled water holding a grain of *pure vitriol of iron* in solution, add a few drops of the wine-test; immediately a *black precipitate* will be formed as in Exp. CXL. which will *disappear* again on the addition of a few drops of the vitriolic acid F.

### Experiment CXLVI.

Into a wine-glass full of distilled water let fall a few drops of the *solution of lead*, and in like manner an *almost black precipitate* will be pro-

duced, which, on the addition of vitriolic acid, will *not* be redissolved. Compare with this Exp. CXIV.

### Experiment CXLVII.

If a few drops of the *solution of vitriol of copper* E. E. are put into a wine-glaſs full of distilled water, and a few drops of the wine-test added to it, a precipitate of a *blackiſh brown* colour will be produced, which; just as was the case in Exp. CXLI. will *not* disappear on the addition of vitriolic acid.

### Experiment CXLVIII.

Having dissolved one grain of *emetiſt tartar* in a wine-glaſs full of distilled water, to this add a few drops of the wine-test; an *orange-coloured precipitate* will be produced as in Exp. CXXXIX. In the same manner will this wine-test act upon *butter of antimony*.

For the action of the wine-test upon *ponderous earth, silver, and mercury*, see Experiments LXXXVI. XCIV. C. CVII. According to Dr. *Hahnemann*\*, corrosive sublimate produces with hepatic-air water a *yellowiſh brown* colour, which

\* I. c. p. 241.

afterwards turns to *white*. This latter circumstance I have not found ; the precipitate exhibited a *yellowish brown*, and retained this colour unchanged even for some days afterwards. See Exp. CVII,

I. I. *Highly rectified spirit of wine.*

According to *Westrumb*\* all the vitriolic neutral salts are separated from a liquid, by mixing with it equal parts of this spirit of wine. When added to a liquid in a larger proportion, it also separates the saline neutral salts composed of nitrous and marine acid ; but not the *metallic* or *terrene* salts compounded of these acids. If in the separation of these salts, by means of vinous spirit, sufficient care be taken, many other sorts of salts likewise that are contained in a liquid may be separated by it from each other, after being reduced by evaporation to a solid state ; because many salts are soluble in spirit of wine, while others again are insoluble†. Besides these,

\* l. c. p. 110.

† Wenzel's Doctrine of the Affinities of Bodies. Dresden, 1782, p. 428. Lavoisier's Physico-chemical Essays, vol. ii. p. 143.

resinous and æthereo-oily substances may also be extremely well separated by means of spirit of wine.

### Experiment CXLIX.

Dissolve three grains of the *pure Epsom salt* C. C. in a quarter of an ounce of distilled water, and add to it an equal quantity of highly rectified spirit of wine. The mixture will become turbid, and by degrees small *crystals of Epsom salt* will be formed at the bottom of the glass. This vinous spirit will also act in the same manner upon other saline liquids, e. g. such as hold *vitriolated tartar*, *Glauber's salt*, *nitre*, &c. in solution.

### Experiment CL.

Mix a few grains of *diuretic salt*, or *foliated earth of tartar*, with a few grains of *vitriolated tartar*; put them into a phial furnished with a stopper that fits it well, and after pouring a little spirit of wine upon them, set the mixture in a warm place: the diuretic salt will be dissolved by the spirit, and the vitriolated tartar remain undissolved behind. Separate the liquor carefully from the vitriolated tartar, and evaporate the

vinous spirit: by this means the diuretic salt will be left behind in a separated state. To the salts which are soluble in spirit of wine may chiefly be referred besides, *common salt with a calcareous basis*, *common salt with basis of magnesia*, *nitre with basis of magnesia*, *nitre with a calcareous basis*, &c.

### Experiment CLI.

Mix one grain of *resin of jalap*, or of any other *resin* soluble in spirit of wine, with a few grains of vitriolated tartar, or with any other substance that is insoluble in spirit of wine, and pour as in Exp. CL. a little of the vinous spirit upon them; the resin will be dissolved in the spirit, and the salt will remain undissolved behind. Pour off the liquor carefully, and, by adding distilled water to it, separate the resin.

### Experiment CLII.

Mix a few drops of oil of almonds, or of the best falladoil, with a few drops of any æthereal oil, as for instance, *oil of cloves*, and pour spirit of wine upon it; the oil of cloves will dissolve in the spirit, and the oil of almonds remain undissolved behind. Endeavour to pour off

off the spirituous part of the liquor from the oil of almonds, and add distilled water to the former: the water will now unite with the spirit of wine, and by this means the oil of cloves will be separated.



---

---

THE USE OF THE COLLECTION TO CHEMISTS,  
PHYSICIANS, MINERALOGISTS, METALLUR-  
GISTS, PROJECTING ARTISTS, MANUFAC-  
TURERS, FARMERS, AND THE CULTIVA-  
TORS OF NATURAL PHILOSOPHY.

---

I.

*The use of the collection to Chemists.*

THE Chemist must necessarily be acquainted with all the re-agents that are contained in this collection, and their different effects; he also knows the sources from whence he may procure the information necessary for his researches; and, as he occupies himself with researches of every kind, whether they appertain to medical Jurisprudence, Mineralogy, Metallurgy, the Arts, or rural Oeconomy, it is not ne-

cessary, in this place, to direct his attention to particular cases.

## II.

### *The use of the collection to Physicians.*

The principal cases in which the Physician has need of these tests are—1. the examination of mineral waters. 2. the examination of wines or cyder which are suspected to be adulterated. 3. the detection of the administration of poison, whether it be effected by corrosive sublimate, arsenic, or by any other metallic solution. 4. the discovery of the genuineness of galenical or chemical preparations, at visitations of apothecaries shops.

### *Examination of mineral waters.*

As the physician must necessarily be acquainted, from chemistry, with all the circumstances necessary to be practised in investigations of this kind, I need not dwell long upon this subject. The following are the principal substances that have in these latter times been found to exist in mineral waters:—1. *Uncombined fixed air.* 2. *Hepatic air.* 3. *Chalk, or calcareous earth united with fixed air.* 4. *Magnesia united with fixed air.* 5. *Iron combined with*

with fixed air. 6. Mineral alkali united with fixed air. 7. Glauber's salt. 8. Vitriolated tar-  
tar. 9. Gypsum. 10. Epsom salt. 11. Alum.  
12. Martial vitriol. 13. Prismatic nitre. 14.  
Nitre with a calcareous basis. 15. Nitre with  
basis of magnesia. 16. Common salt. 17. Com-  
mon salt with a calcareous basis. 18. Common  
salt with basis of magnesia. 19. Sulphur. 20. Li-  
ver of sulphur. 21. Extractive matter.

Now accordingly as one of these substances  
remarkably predominates in mineral waters, or  
is contained in a greater quantity than others  
in them, these waters are farther divided into—  
1. *Bitter purging waters.* 2. *Alkaline waters.*  
3. *Muriatic waters.* 4. *Chalybeate waters.* 5.  
*Sulphureous waters.* 6. *Nitrous waters.*

In the examination of mineral waters there-  
fore the physician ought to pay particular atten-  
tion to the constituent parts here indicated;  
but for the manner in which these constituent  
parts are to be discovered by the re-agents, I  
must refer the reader to the above-mentioned  
experiments. Thus we shall discover—

1. *Fixed air*, by Exp. 2. 5. 21. 27. 31. 32.

78.

2. *Hepatic air*, by Exp. 29. 86. 94. 107.  
114. 117. 120. 133.
3. *Calcareous earth united with fixed air*, by  
Exp. 8. 14. 22. 31. 32. 50. 79.
4. *Magnesia united with fixed air*, by Exp.  
8. 14. 22. 56. 79.
5. *Iron combined with fixed air*, by Exp. 41.  
47.
6. *Mineral alkali united with fixed air*, by  
Exp. 10. 13. 18. 98. 105. 122. 124. 126.
7. *Glauber's salt*, by Exp. 84. 88. 90. 97.  
110. 149.
8. *Vitriolated tartar*, by Exp. 84. 88. 90.  
97. 110. 149.
9. *Gypsum*, by Exp. 15. 51. 59. 63. 68. 74.  
80. 84. 90. 97. 110. 129.
10. *Epsom salt*, by Exp. 34. 57. 66. 70. 75  
80. 84. 90. 97. 110. 128. 149.
11. *Alum*, by Exp. 34. 58. 64. 70. 80. 84.  
90. 97. 110. 130.
12. *Martial vitriol*, by Exp. 42. 48. 61. 71.  
81. 84. 101. 102. 140. 145.
13. *Prismatic nitre*, by Exp. 25. 149.
14. *Nitre with a calcareous basis*, by Exp. 23.  
25. 51. 59. 63. 66. 68. 74. 80. 129.

15. *Nitre*

15. *Nitre with basis of magnesia*, by Exp. 25.  
 34. 57. 66. 75. 80. 128.

16. *Common salt*, by Exp. 25. 89. 90. 96. 111.

17. *Common salt with a calcareous basis*, by  
 Exp. 23. 25. 51. 57. 66. 70. 75. 80.  
 90. 96. 111. 128. 149.

18. *Common salt with basis of magnesia*, by Exp.  
 25. 34. 57. 66. 75. 80. 90. 96. 111. 128.

19. *Sulphur*, by Exp. 119. 120.

20. *Liver of sulphur*, by Exp. 28. 85. 93. 99.  
 106. 113. 116. 119. 132.

28. *Extractive matter. T.*

Now, when it is discovered by the re-agents, which are the constituent parts that are principally to be attended to, we must endeavour to determine the quantity of these constituent parts, as exactly as possible, in the dry way: but, as it is beside my plan to treat in this place of the examination of bodies in the dry way, I beg leave to refer the reader to the following authors:

*T. Bergman de Analyſi Aquarium in Opusc. Phys. et Chem. vol. i. p. 68.*

*Strachling, Methodus Generalis explorandi Aquas Medicatas. Poson et Lipsiæ, 1775.*

*Westrumb, Inſtructions with respect to the*

Examination of Mineral Waters, in his Physico-chemical Essays, vol. i. part 2, p. 71.

*Examination of Wines of a suspected Quality.*

Of all possible modes of adulterating wines, that is the most hurtful to the constitution which is effected by *lead*; in examining wine of a suspected quality, therefore, particular attention ought to be paid to this mode of adulteration. Lead is known to produce, with vegetable acids, a salt similar in its taste to sugar (*viz.* sugar of lead); but this agreeable taste may also be imparted to acid wines, which, by this means, will be rendered palatable. Now in order to discover this highly reprehensible adulteration, the *Wurtenburg wine-test*\* (as it is called) has for many years past been generally used; till at length it was found that a common solution of liver of sulphur will have the same effect. It is sufficiently well known in chemistry, that from the liver of sulphur, and consequently also from the *Wurtenburg wine-test*,

\* This is usually made of two parts of orpiment, four of quicklime, and twelve of water, by boiling them up together, and then filtering off the liquor.

the

the dissolved sulphur is precipitated, by any pure acid, of a *white* (Exp. 28. 137.) or *pale yellow* colour; but if the acids contain heterogeneous particles, and particularly metals, the precipitated sulphur appears of a more or less *dark* hue. (Exp. 85. 93. 99. 106. 113. 140. 141.) Now every kind of wine, by means of the uncombined portion of vegetable acid it contains, effects the very same precipitation; and if, on the examination of any kind of wine, the precipitate chanced to turn out of a rather darkish cast by this wine-test, the merchant from whom the wine was bought was immediately considered as criminal. I could here adduce several melancholy instances, in which, even in these later times, vintners of the greatest probity, merely in consequence of a faulty examination of a parcel of wine with the Wurtenburg wine-test, have lost both their character and fortune; and in which, after a more accurate investigation, the merchant's innocence was proved. It may be perfectly right to suspect wine, which exhibits a dark precipitate with this wine-test, of containing metallic particles; but it does not absolutely follow that it contains a metal prejudicial to health. The wine may

take up particles of iron (which however are more conducive than hurtful to health), either in the first preparation of it, in the pressing for instance, in which instruments are always used that have iron in their composition ; or it may take these particles from the nails which may chance to be about the cask in which it is kept ; and in this case it will in like manner exhibit with the wine-test, or with any other liver of sulphur, a dark-coloured precipitate (Exp. 140). I have also known, and that not from others, but from my own reiterated experience, wines of different colours to produce precipitates of a colour totally different from their own ; although at the same time I was perfectly convinced that they contained neither lead nor iron, and that therefore the colour proceeded merely from a greater or less quantity of oily particles naturally contained in all wines, especially when they are old. Hence it is certain that every liquid which is to be used as a wine-test, is defective, if it yields a precipitate with neat wines.

In the great progress which chemistry has made of late years, it could not fail of finding out a less fallible remedy, possessing all the qualities necessary for this purpose; *viz.* 1. That

of

of not producing any precipitate with genuine wine: 2. Of not precipitating iron contained in the wine: 3. Of indicating the presence of lead, or of any other metal prejudicial to health, by a more or less dark-coloured precipitate. This means is now discovered; and is that which occurs in the Collection under the name of *hepatic-water*, or Dr. *Hahnemann's Wine-test*; the composition of which, consisting of calcareous liver of sulphur, cream of tartar, and water, is described at No. II. in the Introduction, and of which the effect is known from Exp. 142. 143. 145. 146.

Now the examination of a parcel of wine of a suspected quality is performed in the following manner:—To two or three ounces of wine add a spoonful of this wine-test newly prepared: if the wine is entirely without any noxious metal, it will remain transparent, and not become turbid in the least; but if it contains *lead*, or any other *metal* of a *deleterious nature*, more or less of a dark precipitate will appear, according as more or less of these metallic particles are present. If there be any iron in the wine, it may be discovered—

1. By the addition of a few drops of tincture of galls (Exp. 48).
2. By the hepatic water. No. I.
3. If to the wine that has been mixed with *Hahnemann's wine-test* No. II. a few drops are added of the solution of the fixed vegetable alkali O, by which means the redundant acid, that holds the iron in solution, is taken away, this wine-test becomes similar to that of No. I. and the iron will then discover itself by a *black precipitate* (Exp. 145), which will disappear again on the addition of a few drops of vitriolic acid.

Now, in order to render this test still more convincing, dissolve in four ounces of any neat wine a few grains of sugar of lead, and in four ounces more of the same wine a few grains of martial vitriol, and filter off both the solutions very nicely. Now if the above experiments are repeated with these wines, all that has been advanced before, will be found to be perfectly confirmed ; and these experiments may be considered equally as trials of a wine that has been accidentally impregnated with iron, and of one that has been intentionally adulterated with lead.

In

In order also to be convinced of the usual Wurtenburg wine-test being really defective, prepare it according to the prescription given above, and compare its effects with those of *Hahnemann's*.

If Dr. *Hahnemann's* wine-test indicates the presence of a very small portion only of lead, and still the quantity of it is to be determined in a summary way, a certain quantity of the wine is to be boiled down to the fourth or eighth part; and if it be rendered turbid by these means, it must be filtered. To the wine thus filtered, vitriolic acid is to be added, till no more white precipitate is formed. This precipitate, which is vitriol of lead (Exp. 110), is to be separated, and, when it is become dry, accurately weighed. Now, according to *Bergman*, 143 grains of this precipitate contain 100 grains of lead; but, besides this, must be taken into the account, for every 20 ounces of the liquid, one grain more of vitriol of lead, that remains dissolved in it.

Vid. *Hahnemann on the Wine-test for Iron and Lead in Crelle's Chemical Annals 1778, vol. i. p. 291.*

### *Poisons.*

Corrosive sublimate and arsenic being the strongest of all the known mineral poisons, and  
of

of which a very small quantity is sufficient to occasion death; the detection of such poisons is one of the most important objects of attention to the physician. If the poisoned person has taken *corroitive sublimate*, the presence of this salt may be demonstrated by Exp. 35. 104. 105. 106. 107. Whether the blaine is to be laid on *arsenic* or not, may be learned from Exp. 37. 116. 117. 131. 135. 138. 144. But, as people may be poisoned also by means of other metals, when dissolved in acids, *viz.* by *lead*, *copper*, *regulus of antimony*, &c. in order to discover this, the experiments 38. 39. 72. 76. 139. 141. 146. 147. 148. are to be made.

As a great deal depends upon investigations of this kind, which must be made conscientiously, and the supposed poison also must be frequently collected into one mass by very tedious operations; it would certainly be necessary to lay down here ample and circumstantial instructions for this purpose. But as Dr. Hahnemann, in the above-mentioned book, p. 26, has made known every precaution that it is possible to take, and I should be under the necessity of merely giving extracts of them here, I beg leave to refer the reader to the book itself.

TO DISCOVER THE GENUINENESS OF CHEMICAL  
AND GALENICAL PREPARATIONS, AT THE  
VISITATIONS OF APOTHECARIES SHOPS.

*Examination of saline preparations.*

*Vitriolic Acid.*

(Acidum Vitrioli.)

The *Vitriolic acid*, kept in the shops under the name of *Oil of Vitriol* or *Spirit of Vitriol*, may carry over with it in the distillation a small quantity of *copper* or *iron*, or it may be accidentally impregnated with either of these metals by a careless and slovenly management of the process: and the English oil of vitriol, prepared from sulphur, is said frequently to hold *lead* in solution; this latter has also frequently been found to have a little vegetable alkali combined with it. Now, in order to discover this admixture, a little of the vitriolic acid, that is suspected to be impure, is to be diluted with distilled water, and saturated with the *mild vegetable alkali O*, by which means the copper, iron, and lead will be thrown down in the form of a more or less dark-coloured precipitate.

This

This precipitate is to be thoroughly edulcorated with distilled water, and dried. If then the caustic volatile alkali P be poured upon it, the *blue colour* which the alkali receives from it, will shew that copper is present (Exp. 72). The blue liquid is to be washed off again from the precipitate with distilled water, and the remainder dissolved in pure marine acid. Now if on adding to the solution a little of the wine-test No. II. a *blackish brown precipitate* appears, it is a sign that it contained lead; and any iron that may happen to be present, will be found in the liquid that remains after the separation of this dark precipitate. Vegetable alkali, contained in this acid, is not easily to be discovered by the re-agents. The vitriolic acid may be saturated with the volatile alkali P. or Q., and to this solution may be added a few drops of acid of tartar dissolved in distilled water; when the latter will unite with the vegetable alkali that is present, and be deposited in the form of *cream of tartar*. If the quantity contained in the acid be not very small indeed, it may also be discovered, by mixing the vitriolic acid with equal parts of spirit of wine. By this means

the

the mixture will become turbid, and a quantity of *vitriolated tartar* be separated from it in the form of slender sharp-pointed crystals (Exp. 149).

*Nitrous acid.*

*Nitrous acid* may be rendered impure by the admixture of *vitriolic* or *marine* acid. The *vitriolic* acid may be discovered in it, by adding to it a few drops of the solution either of ponderous earth, or of sugar of lead S. Z. and the *marine acid* by the solution of silver T. In the first case, ponderous spar or vitriol of lead, and in the latter luna cornea, is generated (Exp. 83. 89. 110).

*Marine acid.*

(Acidum Salis.)

*Marine acid* may contain *vitriolic acid*, *copper* and *iron*. The *vitriolic acid* is discovered by the solution either of ponderous earth or of sugar of lead (Exp. 83. 110). The presence of *copper* is detected by supersaturating the acid with deaerated or caustic volatile alkali P. (Exp. 72.) The presence of *iron* is manifested by saturating the acid with the fixed alkaline salt O. and then adding to it tincture of galls (Exp. 48).

*Vine-*

*Vinegar.*  
(Acetum.)

*Vinegar* may be mixed with the *vitriolic*, *marine*, and *tartareous acids*. The first of these admixtures is discovered by the solution either of ponderous earth or of sugar of lead S. Z. (Exp. 83. 110.) the *marine acid* by the solution of silver T. (Exp. 89.) and the *tartareous acid* by saturating the vinegar with the *vegetable alkali* O, in consequence of which cream of tartar will be separated in the form of a white powder. If there should chance to be any *copper* in the vinegar, it may be discovered by saturating it with the volatile alkali P. Q. (Exp. 76).

*Distilled vinegar.*  
(Acetum distillatum.)

*Vinegar* is frequently distilled, not in glass vessels, but in a still with a pewter head; in which case it is liable to take up particles of lead from the distilling vessel, the pewter being seldom free from *lead*. This circumstance may be discovered by the wine-test H. II. which will produce a precipitate of a *blackish brown* colour (Exp. 114. 146).

*Essential*

*Essential Acid of Tartar.*

(Acidum Tartari essentiale.)

*Essential Acid of Tartar* may very easily be contaminated with *vitriolic acid*, either intentionally, or in consequence of a faulty preparation. This admixture of vitriolic acid is soon discovered, if a small quantity of the acid of tartar be dissolved in distilled water, and a few drops of the solution of lead Z. added to it; by this means a white precipitate is produced, which, by the addition of a few drops of the pure nitrous acid G. will be entirely redissolved, if no vitriolic acid is contained in it. The presence of vitriolic acid is still more readily manifested, by adding to the acid of tartar dissolved in distilled water, a few drops of the solution of ponderous earth S. in consequence of which ponderous spar is immediately generated. (Exp. 83.)

*Salt of Amber.*

(Sal Succini.)

On account of the high price which Salt of Amber bears, it is often purposely adulterated with *vitriolic acid* and its compounds, with *acid of tartar*, and perhaps now and then with *sal ammoniac*. The *vitriolic acid* is discovered by means

of the solution of ponderous earth, or of sugar of lead S. Z. (Exp. 83. 84. 110.) by letting fall a few drops of either into the solution of salt of amber in distilled water. The *acid of tartar* is discovered by the vegetable fixed alkali O. by adding a few drops of this salt to the solution of it ; for if this be present, a quantity of cream of tartar will fall to the bottom. The presence of sal ammoniac is discovered, with respect to one of its component parts, the marine acid, by the solution of silver T. (Exp. 90.) ; and with respect to the other, the volatile alkali, by adding to the solution of this salt in distilled water, a few drops of the fixed alkali N. or O. and, after heating the mixture, holding over it a stopper moistened with acetous acid. (Exp. 54.)

### *Sedative Salt.*

(*Sal sedativum Hombergii.*)

Genuine *Sedative Salt* is soluble in five times its quantity of boiling hot spirit of wine, and the solution, when set fire to, burns with a *green flame*. Submitted to the blow-pipe it fluxes to a transparent glass, soluble in water, and vitrifies earths and stones. If it be added in small quantities to cream of tartar, it transforms this substance

substance into a very soluble salt, known by the name of *Boracic Tartar*.

*Salt of Tartar.*

(*Sal Tartari.*)

Instead of pure *Salt of Tartar*, we frequently meet with mere purified pearl-ashes, which however are seldom free from heterogeneous particles. This salt has often *siliceous earth* mixed with it, and perhaps other heterogeneous salts, composed of *vitriolic* and *marine acid*. In order to discover the presence of *siliceous earth*, a little of the salt is dissolved in distilled water, and saturated with any of the pure acids in the collection, by which means the siliceous earth is precipitated ; by the same process other earths also, which may chance to be mixed with it, are separated. *Vitriolic acid* is discovered by dissolving the alkali in distilled water, saturating it with pure nitrous or acetous acid, and then adding to it a few drops of the solution of ponderous earth or of sugar of lead S. Z. when a precipitate will be produced. (Exp. 83. 84. 85. 110.) The presence of *marine acid* is manifested, by adding to this salt saturated with nitrous acid, a few drops of the solution of silver

T. (Exp. 89. 90.) in consequence of which *luna cornea* is generated.

*Mineral Alkali.*

(*Alkali minerale.*)

*Barillas* contain for the most part, besides mineral alkali, other *heterogeneous salts*, which remain mixed with the mineral alkali obtained from it by elixation; in like manner also it is difficult to separate this alkali from *Glauber's* or common salt in so pure a state that it shall not retain a little *vitriolated tartar* or *common salt*. If it is purchased in the form of powder, it may likewise be adulterated purposely with *Glauber's salt* or *salt of tartar*. In order to discover the vitriolic and marine salts that are sometimes mixed with it, proceed in the same manner as with the *salt of tartar*; and the vegetable alkali is discovered in it, by adding to a solution of mineral alkali a few drops of the acid of tartar, by which means *cream of tartar* will fall to the bottom of the vessel.

*Caustic Spirit of Sal Ammoniac.*

(*Spiritus Salis Ammoniaci cum Calce viva.*)

In order to discover, whether the *Caustic Spirit*

*rit of Sal Ammoniac* be entirely free from fixed air, mix with it a small quantity of a solution of pure calcareous earth in the marine acid, which may be easily prepared from a little quick-lime and the marine acid contained in the collection; if the spirit be entirely free from fixed air, *no precipitate* will appear, when a little of this solution of calcareous earth is mixed with distilled water, and a few drops of the caustic spirit that is to be examined are added to it. But if mild or aerated calcareous earth falls to the bottom, (Exp. 74.) the volatile spirit was not entirely free from fixed air. If *mineral chamaeleon* is at hand, it may serve for a test just as well as this; for the spirit, if there be any fixed air in it, will be tinged *red* by this preparation; but if it be perfectly caustic, it will remain *green*.

### *Concrete volatile Alkali.*

(Alkali volatile.)

This salt should be *totally volatile*; for if any one should attempt to put off a mixture of sal ammoniac and salt of tartar for it, the heating a little of it upon an iron instrument would soon shew this adulteration, as digestive

salt would remain behind. This alkali, when dissolved in no greater quantity of distilled water than it requires for its solution, if the solution be mixed with spirit of wine, will concrete into a *crystalline mass*, because the volatile alkali is separated by the spirit of wine. (Exp. 149.)

*Salt of Hartshorn.*

(*Sal Cornu Cervi volatile.*)

The genuineness of *Salt of Hartshorn* may be discovered in the same manner as that of volatile alkali; as it differs from the latter merely in being impregnated with a small quantity of animal-oily particles.

*Spirit of Hartshorn.*

(*Spiritus Cornu Cervi.*)

Fraudulent chemists are accustomed to cohobate their *Spirit of Hartshorn* upon quicklime, in order to make it the stronger, and thus to give to a weak spirit the appearance of one well saturated with volatile alkali. This fraud may be discovered, by adding spirit of wine to the spirit of Hartshorn; for if *no crystallized volatile alkali* appears in consequence of this addition, (Exp. 149.) the adulteration above indicated

may.

may be suspected ; it may even be discovered by the circumstance of the spirit not effervesing briskly with acids.

### *Glauber's Salt.*

*Glauber's Salt* ought to contain neither *redundant acid* nor *alkali*, neither should it be mixed with earthly salts : the first of these defects is discovered by means of the tincture of litmus, and the different coloured papers, (Exp. 3. 6. 10. 13. 18.) by examining the solution of this salt with them in distilled water. The presence of the earthy salts in this salt is discovered, by adding to the solution of it a few drops of the pure mild *vegetable alkali* O. (Exp. 63. 64. 65. 66.) and the presence of marine acid will be manifested by Exp. 25. 89. 90.

### *Vitriolated Tartar.*

(*Tartarus vitriolatus.*)

The impurities in *Vitriolated Tartar* may be the same as those in *Glauber's salt*, and may be discovered by the same means. Very frequently the *caput mortuum*, which remains after the distillation of *aqua fortis* by means of vitriol, is, after elixation and crystallization, made

use of for this salt. But as chemists for the most part are not sufficiently careful with respect to the addition of vitriol, nor indeed know how to purify this salt in a proper manner ; it frequently happens, that a little undecomposed vitriol remains mixed with this salt, and for that reason contains not only *vitriol of iron*, but perhaps also of *copper*. In order to discover this, dissolve a little of this salt in distilled water, and add a few drops of the vegetable fixed alkali O. to it ; if a precipitate appears, the salt is not pure. The precipitate being collected, and redissolved in marine acid, it may be easily found whether *iron* and *copper* are present or not, by Exp. 48. and 72.

### *Nitre.*

#### (Nitrum.)

To *Nitre*, from a fault in the purification of it, there frequently adhere particles of *marine salt*, or else it is purposely adulterated by fraudulent chemists with *Glauber's salt*. The latter circumstance is immediately discoverable, by the *bitter* taste that is intermixed with the genuine taste of the salt, and by the *inferior* liveliness of its detonation. Besides this, any particles of

marine

marine salt that may adhere to it, may be detected by the solution of silver, T. (Exp. 89. and 90.) and the presence of *Glauber's salt* by the solution of ponderous earth, and by that of lead, S. Z.

*Sal Ammoniac.*

(*Sal Ammoniacum.*)

*Genuine Sal Ammoniac*, when laid on a red-hot iron, ought to fly off entirely, and when it is perfectly free from *vitriolic acid*, and a little of it is dissolved in distilled water, does *not* form a *precipitate*, on a few drops of the solution of silver or of that of lead, S. Z. (Exp. 83. 84. 110.) being added to it.

*Diuretic Salt.*

—(*Sal diureticus, or Terra foliata Tartari.*)

*Genuine Diuretic Salt* is perfectly soluble in four times its weight of spirit of wine, and therefore such heterogeneous salts as are mixed with it, and which are *insoluble in spirit of wine*, may be discovered by these means, as they remain behind undissolved. A few drops of nitrous or marine acid added to a solution of this salt in

distilled

distilled water, ought not to separate cream of tartar from it, but the acetous acid must be disengaged by this means; which latter circumstance is perceived by the sour smell of the vinegar that is making its escape. In case the diuretic salt has been prepared by precipitating sugar of lead with fixed vegetable alkali, and, in consequence of a bad management of the process, some particles of lead have remained with it; this circumstance may be discovered, by pouring to the solution of this salt a little hepatic water, II. (Exp. 46.) by which means a *precipitate of a dark brown colour* is formed, which is not capable of being redissolved by the addition of a few drops of vitriolic acid.

*Rochelle Salt, or Salt of Seignetti.*

(*Sal Rupellense, sive Polychrestum Seignetti.*)

The external crystalline form of *Rochelle Salt* sufficiently shews when it is adulterated with *Glauber's salt*. But if a little of it is dissolved in distilled water, and some of the solution of lead Z. is added to it, a *white precipitate* is formed, which is not redissolved, by the addition of a few drops of the nitrous acid G. If a few drops of any of the acids contained in the collection are added

added to a solution of genuine Rochelle salt, a quantity of *cream of tartar* will be separated from it.

*Soluble Tartar.*

(*Tartarus solubilis, or Tartarus tartarisatus.*)

*Soluble Tartar* does not crystallize so easily as Rochelle salt, but it is liable to be adulterated with the same salts as Rochelle salt, and for this reason the adulteration of it may be discovered in the same manner.

*Epsom Salt.*

(*Sal catharticus amarus.*)

*Epsom Salt* may contain *magnesia salita*, i. e. *magnesia saturated with marine acid*, as also *Glauber's salt*. If it contains the former, it readily becomes moist, and from the solution of it in distilled water, the solution of silver T. (Exp. 89. 90.) will precipitate *luna cornea*. If this salt falls to powder by exposure to a dry air, it contains *Glauber's salt*. Mere *Glauber's salt* likewise is frequently substituted for it; when, in order to obtain such small crystals as those of *Epsom salt*, the crystallization is interrupted by stirring the liquid at the instant that it is going

to

to crystallize. This latter fraud may be discovered, by dissolving and crystallizing it afresh: likewise if it is mere Glauber's salt, the solution of vegetable alkali O. will not separate any magnesia from it.

*Alum.*

(Alumen.)

Perfectly pure *Alum* ought to consist merely of earth of alum and vitriolic acid, and contain no *iron* nor *copper*. *Iron* is discovered by dissolving a little of the alum in distilled water, and adding a few drops of the lixivium of Prussian blue F. or tincture of galls K. when, in the former case a *blue*, and in the latter a *black* precipitate will be formed. (Exp. 42. 48.) *Copper* may be detected by the caustic volatile alkali P. (Exp. 72.)

*Borax.*

(Borax.)

*Borax*, which should consist of mineral alkali and sedative salt, is liable to be mixed with other salts that resemble borax in their external form, E. G. with *alum* or *sal gem*. The *alum* is discovered by dissolving a little of the borax in distilled water, and pouring so much of the marine

rine acid to it, till the redundant alkaline part is perfectly saturated, and then adding to it a few drops of the solution of ponderous earth S. Now if there be any vitriolic acid in it, a real ponderous spar will, according to Exp. 83. and 84. fall to the bottom of the vessel. The alkaline part that is redundant in the borax, must be previously saturated with marine acid ; for this reason, that this acid may not be able to act upon the solution of ponderous earth, and produce a precipitate with it. If marine acid be present, it will be made manifest by Exp. 25. or it may be discovered by the solution of silver, T. (Exp. 92.) provided the redundant alkaline part be previously saturated with the pure nitrous acid G.

*Mindererus's Spirit.*

(*Spiritus Mindereri.*)

The genuineness of *Mindererus's Spirit* may be discovered in the same manner as that of *sal diureticus* ; and the presence of the volatile alkali is manifested by the *volatile smell* that takes place, when a little of the solution of vegetable alkali O. is added to it, and the liquid is made warm ; at the same time too its presence will

will be demonstrated by the *clouds* which appear, if a stopper moistened with acetous acid M. (Exp. 54.) is held over the surface of this liquid.

*Succinated Salt of Hartshorn.*

(*Liquor Cornu Cervi succinatus.*)

This *liquor* should, in strict propriety, be composed of salt of hartshorn perfectly saturated with salt of amber. But this latter article being very dear, other acid salts are frequently combined with the salt of hartshorn, and this mixture is substituted for succinated salt of hartshorn. Now if it contain either the *marine*, *nitrous* or *acetous acid*, the fraud may be discovered, by adding a few drops of vitriolic acid to the liquid, warming it, and holding over its surface a stopper moistened with volatile alkali, when the heterogeneous acid becomes visible by the *clouds* that are formed on this occasion. (Exp. 54.) The presence of *marine acid* may also be discovered by the solution of silver T. pursuant to Exp. 89. 90.

*Cream of Tartar.*

(*Cremor Tartari, Crystalli Tartari.*)

*Cream of Tartar*, or Crystals of Tartar, being a

combination of vegetable alkali supersaturated with acid of tartar, is known by the peculiar smell it yields, when placed upon burning coals. If cream of tartar be adulterated with any of the vitriolic salts, the solution of lead Z. added to a solution of the former, will form a *white precipitate*, which is not soluble again in the nitrous acid. Any *copper* it may chance to contain is discoverable by the volatile alkali, purfuant to Exp. 72.

*White Vitriol.*

(Vitriolum Zinci.)

When *White Vitriol* is to be used as a medicine, it must consist entirely of zinc and vitriolic acid, and shoule contain neither *iron* nor *copper*; though *iron*, it is true, would do no harm in it. *Copper* is discovered by means of volatile alkali, (Exp. 72. and 76.) by adding a little of it to a solution of white vitriol in distilled water. The presence of *iron* is detected by the tincture of galls K. purfuant to Exp. 48.

*Emetic Tartar.*

(Tartarus emeticus.)

*Emetic Tartar*, a combination of calx of antimony

mony with cream of tartar, forms, it is true, when genuine, a white precipitate with the solution of lead Z. but is soluble again by the nitrous acid G. If a little emetic tartar be dissolved in distilled water, and a few drops of the volatile liver of sulphur G. G. or of the hepatic water H. H. be added to it, a sulphur auratum antimoniī, or mineral kermes, will fall to the bottom of the vessel. (Exp. 139. 148.)

*Butter of Antimony.*

• (Butyrum, *five* Oleum Antimonii.)

*Butter or Oil of Antimony* should consist of calx of antimony and marine acid ; and, if it be genuine, the white calx of antimony, which is soluble in vegetable acids, will be precipitated from it by the addition of distilled water. The volatile liver of sulphur G. G. and the hepatic water H. H. act upon it in the same manner as they do upon emetic tartar. (Exp. 139. 148).

*Corrosive Sublimate.*

(Mercurius sublimatus corrosivus.)

*Corrosive Sublimate*, which should consist of Mercury supersaturated with marine acid, is often suspected to be adulterated with *arsenic*.

Though

Though this may probably seldom be the case, yet, when it is, the fraud may be discovered in the following manner: Dissolve a small quantity of the sublimate in distilled water, precipitate the mercury out of it by the mild volatile alkali Q. and filter the liquid, in order to separate the precipitate, which is white: now if, on the addition of a few drops of the cuprum ammoniacum F. F. to this filtered liquor, a transparent *blue* liquid is formed, the corrosive sublimate is free from arsenic; but if a precipitate of a *yellowish green colour* is produced, (Exp. 135.) then it contains arsenic. How corrosive sublimate is affected by lime-water and alkaline salts, may be seen in Exp. 35. 104. 105.

*Calomel.*

(Mercurius dulcis.)

In Calomel the marine acid must be completely saturated with mercury, and in this state it is said to be *perfectly dulcified*. This is known to be the case, when, upon a little of it being rubbed in a glass mortar with the *caustic* volatile alkali P. or with the lime-water H.

L

a black

a black but no orange colour (Exp. 35. 104.) is produced.

*Sugar of Lead.*

(*Saccharum Saturni.*)

If *Sugar of Lead*, which should consist of vinegar saturated with lead, be adulterated with nitre of lead, the fraud will be discovered by the smell of aqua fortis, that will arise, on adding to a solution of it in distilled water, a few drops of the vitriolic acid F. (Exp. 25.) and warming the mixture.

*Vitriol of Copper, or Blue Vitriol.*

(*Vitriolum cœruleum.*)

*Vitriol of Copper* should consist entirely of copper and vitriolic acid; but *iron* and *zinc* may also chance to be combined with it. In order to discover this, dissolve a little of it in distilled water, and add to it a few drops of the caustic volatile alkali P. The liquid, it is true, will become somewhat turbid at first; but by pouring more of the alkaline solution to it, the whole will be redissolved, and form a transparent mixture of a *blue* colour, provided the vitriol be perfectly

fectly pure. But if there be iron in the mixture, a *black calx* will be precipitated, which will become *yellow* on being exposed to the air; but if the precipitate be *white*, it is a sign that the vitriol contains *zinc*.

*Vitriol of Iron, or Martial Green Vitriol.*

(Vitriolum Martis.)

*Vitriol of Iron*, when it is to be used as a medicine, should consist entirely of iron and vitriolic acid, and particularly it should not contain any *copper*. The presence of this latter metal is discovered, by putting into a solution of this vitriol a piece of polished iron, which by this means will be covered with a *coat of copper*.

*Lunar Caustic.*

(Causticum lunare.)

*Lunar Caustic* must be prepared of perfectly pure silver, and nitrous acid; but if the silver, which has been made use of for this purpose, is not free from copper, the lunar caustic will easily attract the *moisture of the air*, and is *not so caustic* as it should be. The presence of *copper* is discovered by the volatile alkali P. Q. (Exp)

72. 76.) by pouring it upon a little of the lumar caustic.

*Investigation of Earthy Preparations.*

*Magnesia.*

(*Magnesia alba.*)

Magnesia should be perfectly free from any admixture with the other absorbent earths. It is frequently found adulterated with *calcareous earth*; and this circumstance is very easily discovered by the vitriolic acid F. for in this case, out of the acid and the calcareous earth a selenite will be formed, (Exp. 23.) which, on the solution of the magnesia by the acid, will remain in the form of a white powder behind. But if a perfectly clear solution is produced by the vitriolic acid, and after some time no selenite falls to the bottom of the vessel, then it is entirely free from calcareous earth. This latter earth also may be discovered, when present in magnesia, by dissolving the magnesia in a rather redundant quantity of nitrous or marine acid, and diluting this solution with 300 parts of distilled water, and then adding mineral alkali to it, till no more white precipitate is produced :

duced : crude calcareous earth, or chalk, will be here precipitated, and the magnesia remain dissolved in the liquor.

*Calcined Magnesia.*

(*Magnesia calcinata.*)

Calcined Magnesia should *not effervesce with acids*, nor have *a caustic taste like quicklime*; and when concentrated vitriolic acid is poured upon it, it ought to acquire a *red heat*.

*Investigation of Metals, and Metallic Preparations.*

*Flowers of Zinc.*

(*Flores Zinci.*)

*Flowers of Zinc*, which are a pure calx of zinc, are liable to be adulterated with whiting: this fraud is discovered by pouring upon them a little of the nitrous acid G. diluted with distilled water, when the calcareous earth will be dissolved with effervescence: now if to this liquid a few drops of vitriolic acid are added, and evaporated by degrees, a true selenite will fall to the bottom of the vessel. (Exp. 23.)

*Mercury, or Quicksilver.*

(Mercurius vivus.)

Mercury should be entirely volatile in the fire, and consequently leave nothing behind it after evaporation; but this latter circumstance will not take place, if it be adulterated with *lead*, *tin*, or *bismuth*. The *lead* which may chance to be contained in it, is discovered by the *sweetish taste* which the acetous acid M. previously diluted a little, acquires, when shaken up with the mercury, or suffered to stand upon it for some time; but, besides this, the presence of lead may be discovered, by adding to this acetous acid, that has stood on the mercury, a few drops of the vitriolic acid F. in which case a *vitriol of lead* will be generated, (Exp. 110.) or by the volatile liver of sulphur G. G. or else by the hepatic water H. H. (Exp. 113. 114. 146.) The *tin* which may chance to be contained in it, is converted into a *white calx* of *tin*, by pouring the nitrous acid G. upon the quicksilver, and consequently its presence may be discovered by this means. If *bismuth* be contained in it, by adding to a solution of this mercury in the pure nitrous acid G. a quantity of distilled water, a *white precipitate* (magiste-  
rium

trium marcasitæ, or Spanish white) will be produced.

*Cinnabar.*

(*Cinnabaris factitia.*)

*Cinnabar*, a combination of sulphur and mercury, may be adulterated with *red lead*; and the fraud is discovered in the same manner as it was in the instance of the mercury, by digesting the cinnabar for some time with a little of the diluted acetous acid M. and examining it pursuant to the Experiments 113. 114. 146.

*Red Precipitate.*

(*Mercurius precipitatus ruber.*)

Genuine *Red Precipitate* is soluble in the nitrous acid G. with generation of heat, but without effervescence; the vitriolic acid F. forms with it Turpeth mineral, and the marine acid corrosive sublimate, or, when it is perfectly saturated with marine acid, calomel. If it be adulterated with *red lead*, the fraud may be discovered in the same manner as in cinnabar, by pouring diluted acetous acid M. upon it, and examining this liquid pursuant to Exp. 113. 114. 146.

*White Precipitate.*

(Mercurius precipitatus albus.)

*White Precipitate* may be adulterated with *white lead*, or with *whiting*. The presence of *white lead* may be discovered by the sweetish taste, that arises in consequence of digesting the precipitate in the acetous acid M. and also by the Experiments 113. 114. 146. If it contain aërated calcareous earth or *chalk*, an effervescence will ensue, on acetous acid being poured upon it, and the calcareous earth will be dissolved in this acid: if a few drops of the vitriolic acid F. are added to it, and the liquid is gradually evaporated, selenite will be formed. (Exp. 23.)

*White Lead,*

(Ceruffa.)

*White Lead*, or lead corroded by the vapours of acetous acid, may be adulterated either with *chalk*, or *ponderous spar*. If upon a small quantity of it the nitrous acid G. be poured, the mere calx of lead will dissolve in it, and the ponderous spar, that is present in the mass, remain behind. But if it contain *chalk*, then add to the solution the vitriolic acid F. till no more

more white precipitate, or vitriol of lead, (Exp. 110.) is formed; when the calcareous earth, that was present in the mixture, will remain dissolved in the nitrous acid, and may then be separated by the mild fixed alkali O.

*Red Lead.*

(Minium.)

*Minium*, a red calx of lead, may be adulterated with *bole Armoniac*, *brick-dust*, or the *caput mortuum of vitriol*. This adulteration may be detected, by pouring a little diluted acetous acid upon the red lead, and letting the mixture stand in a warm place. The calx of lead will be dissolved, and the substances, with which the red lead was adulterated, will remain behind undissolved.

*Tin.*

(Stannum.)

*Tin*, that is to be used as a medicine, ought to be entirely free from *lead*. In order to discover the presence of the latter, the pure nitrous acid G. is to be poured upon the tin, and the mixture set by in a warm place: the pure tin

tin will be corroded by it into a white calx, and the lead, that is present in the mass, will remain dissolved in the acid. Whether any lead is contained in the remaining liquid, may be easily known by the Exp. 113. 114. 146. If, besides, the tin is suspected to contain *arsenic*, the lead, that was dissolved in the nitrous acid, is to be precipitated with the alkaline salt O, and to the liquid, which is filtered off from it, a few drops of the cuprum ammoniacum F. F. are to be added; when, if arsenic be present, a *yellowish green precipitate* (Scheele's green, Exp. 135.) will be formed.

*Verdigrise.*

(*Viride Æris.*)

*Common Verdigrise* is liable to be adulterated with calcareous earth. In order to discover this fraud, dissolve a little of the verdigrise in the diluted vitriolic acid F. when the calx of copper only will be dissolved, and the calcareous earth will remain behind in the form of selenite (Exp. 23.); but if *gypsum* be contained in the mass, the pure calx of copper will be dissolved in the diluted vitriolic acid F. when poured

poured upon it, and the *gypsum* will remain behind undissolved.

*Iron.*

(*Ferrum.*)

Iron, that is to be used as a medicine, must be entirely free from *copper*. The presence of *copper* is discovered by the blue colour which the caustic volatile alkali P. acquires (Exp. 72.) when it is digested with the iron. A small quantity of iron filings also may be dissolved in marine acid, and a polished iron put into this solution, when the iron will be *covered with a coat of copper*, if there be any of this latter metal among the iron filings.

*Kermes mineral.*

(*Kermes minerale.*)

Genuine *mineral Kermes* is perfectly soluble in caustic vegetable alkali. Put a few grains of it into a small phial; pour a little of the caustic alkali N. upon it, and heat the mixture; the kermes mineral will be perfectly dissolved in the alkali; but, as soon as the mixture is

cold,

cold, will be deposited again at the bottom of the phial.

*Golden Sulphur of Antimony.*

(*Sulphur auratum Antimonii.*)

*The golden Sulphur of Antimony* also ought to be perfectly soluble in the caustic vegetable alkali N. and the substances, with which it is adulterated, especially when they are of an earthy nature, should remain undissolved behind. But the kermes mineral *differs* from the sulphur auratum *in this respect*, that it does not separate from the alkali after the solution is grown cold, but remains dissolved in it.

*Preparations of Inflammable Substances.*

*The animal Oil of Dippelius.*

(*Oleum animale Dippelii.*)

*Dippelius's animal Oil*, if it be genuine, and not adulterated with other oils, concretes with the solution of mercury U. so as to form a *yellow mass*, which shortly after becomes black.

*Dulcified Acid of Vitriol.*

(*Spiritus Vitrioli dulcis.*)

*Perfectly dulcified Spirit of Vitriol* ought not to have

have the least sulphureous odour, nor a perceptibly sour taste, and therefore should not impart a red colour to the tincture of litmus A. (Exp. 3.)

*Dulcified Spirit of Nitre.*

(*Spiritus Nitri dulcis.*)

The perfect dulcification of *Spirit of Nitre* is known by this test, that this spirit does not make the tincture of litmus A. red. The tincture of guaiacum, which may be easily prepared of genuine gum guaiacum and the spirit of wine I. I. ought not to produce a *blue colour* with it.

*Vitriolic Ether.*

(*Naphta Vitrioli.*)

*Æther* ought not to contain any uncombined vitriolic acid, nor have the least sulphureous smell. The uncombined vitriolic acid may be discovered by the solution of ponderous earth S. (Exp. 83.) and by the solution of sugar of lead Z. (Exp. 90.)

*Nitrous Ether.*

(*Naphta Nitri.*)

*Nitrous Ether* in like manner ought not to contain

contain any uncombined acid, and for this reason should *not* tinge the tincture of litmus A. *red*, nor the tincture of guaiacum *blue*.

*Essential Oils.*

(*Olea ætherea.*)

The finer kinds of æthereal oils are usually adulterated, 1. with an *inferior æthereal oil*, viz. *oil of turpentine*; 2. with an *unguinous or expressed oil*; 3. with *spirit of wine*. The first of these different modes of adulteration may be perceived by the *smell* of *turpentine* yielded by the adulterated oil, when a few drops of it are poured upon a piece of linen cloth, and the cloth is swung to and fro in the air; in consequence of which, the fine æthereal oil will fly off, and the oil of turpentine remain behind. The *second mode of adulteration* is discovered, by letting a few drops of the oil fall upon paper, and exposing this paper to heat, in consequence of which the æthereal oil will evaporate, and form a *greasy spot*. This mode of adulteration will also be detected, by a little of the *spirit of wine I. I.* being poured upon such oil; the æthereal oil will be dissolved in it, and the *expressed oil* remain

main undissolved behind. The *third mode of adulteration*, viz. that with spirit of wine, may be detected by the addition of water; if a little distilled water be mixed with an oil of this kind, the water will unite with the spirit of wine, and the quantity of æthereal oil contained in the mixture, will then be separated. (Exp. 152.)

*Resin of Jalap.*

(Resina Jalappæ.)

*Resin of Jalap*, on account of its high price, is frequently adulterated, by greedy chemists, with much cheaper resins, viz. colophony, or common resin, &c. or they will sometimes even mix up some *powder of jalap* along with it. The first mode of adulteration may be readily perceived, by its being more brittle than the genuine, and by the smell of turpentine diffused by it; but the latter can only be discovered by dissolving the resin in the spirit of wine I. I. when the powder, that is mixed up with it, will remain undissolved behind. (Exp. 151.)

*Milk of Sulphur.*

(Lac Sulphuris.)

*Milk of Sulphur* is nothing more than sulphur

phur dissolved in an alkaline salt, and precipitated by acids. It is sometimes purposely adulterated with *earth of alum*, *calcareous earth*, or *magnesia*. Such adulteration is best discovered, by pouring upon the milk of sulphur, a quantity of the caustic vegetable alkali N. just sufficient to cover it, and setting the mixture by in a warm place to digest, when the sulphur will be dissolved, and the earths that are mixed with it remain undissolved behind. *Calcareous earth*, when mixed with this substance, is recognizable by the effervescence it produces, when a quantity of the diluted nitrous acid G. sufficient to cover it, is poured upon it, and to the liquor filtered off from it, a few drops of the vitriolic acid F. are added, and a small portion of the mixture is evaporated, in consequence of which genuine crystals of *selenite* will fall by degrees to the bottom of the vessel. (Exp. 23.)

### III.

#### *Use of the collection to Mineralogists.*

The business of the mineralogist is, in the strictest sense of the word, to examine or decompose *Earths* and *Stones*, in order to be able, from their constituent parts, which he has by this

this means discovered, to point out their proper place in the particular system he follows. For this reason mineralogists must be acquainted with the different simple earths occurring in nature, viz. *calcareous, aluminous, magnesian, ponderous* and *siliceous earth*\*<sup>1</sup>, with respect to their properties, and their action upon the different re-agents, in order to assure themselves of the presence of these substances; for, in all probability, it proceeds entirely from the very great variety of mixture in these primary component parts, which principally constitute the bases of the products of the mineral kingdom, that these latter shew themselves in such different forms, that they differ so much from each other in their external characters, and that the decomposition of them and the exact determination of the proportions of their component parts, are frequently so very complicated and laborious. Hence it follows, that a mineral is much easier to be investigated, when it consists merely of calcareous and siliceous earth, than when all the above-mentioned earths, and, besides these,

\* *Klaproth's jargon earth*, as it is but seldom to be met with, cannot for the present be reckoned among the general earthy constituent parts of minerals.

*inflammable matter, iron and acids, are contained in it.*

*Calcareous Earth.*

A mineral, which consists for the greatest part of calcareous earth combined with fixed air, is to be dissolved in nitrous or marine acid; the solution to be diluted with distilled water; that portion of siliceous earth, which may chance to be united with it, to be separated from it by a filter composed of white blotting paper; and, lastly, the calcareous earth is to be precipitated from the solution by means of the mild vegetable alkali O. In order to know whether there be any aluminous earth or iron in the mass, it is necessary to pour upon the precipitate, after it has been well edulcorated and dried, some of the diluted acetous acid M. when the pure calcareous earth only will be dissolved, and the aluminous earth and iron, that may chance to be present in the mass, will remain undissolved behind. The liquid is to be filtered anew, and then the pure calcareous earth is to be precipitated with the solution of vegetable alkali O. The remainder is to be dissolved in marine acid, and the iron it contains precipitated from it with

with the lixivium of Prussian blue I. (Exp. 42.) The liquid is to be separated by filtration ; and, lastly, the aluminous earth, it may chance to contain, is to be precipitated from it by the vegetable alkali O.

If *calcareous earth* occurs combined with *vitriolic acid in the form of gypsum*, a little of the mild vegetable alkali O. is to be poured upon a small portion of it, and set by for some time in a warm place. The alkaline salt will unite with the vitriolic acid, and the calcareous earth with the fixed air, and in this state they will be separated from each other. The mixture must be suffered to stand for a considerable time in a warm place ; and the water, that evaporates, must be replaced by fresh, till the decomposition is completed. This being completed, the vitriolated tartar is to be washed well out of the mass, with distilled water ; after which some of the diluted acetous acid M. is to be poured upon the earth, by which means the separated calcareous earth is dissolved ; and the gypsum, that may happen not to be perfectly decomposed, remains undissolved behind, and may be separated from the former by filtration. To

the filtered liquor a few drops of the lixivium of Prussian blue I. are to be added, in order to discover and separate, pursuant to Exp. 42. the iron that may chance to be present; after which the calcareous earth, that is still held in solution, is to be precipitated from it by means of the alkaline salt O.

### *Magnesia.*

If *Magnesia* is the predominant ingredient in a mineral, it is best discovered by dissolving such mineral in the *vitriolic acid F.* Any calcareous earth, that may chance to be present, is converted into selenite; and earth of alum is known by the *aluminous taste* which it imparts to the salt. The *siliceous earth*, if present, will remain undissolved behind, and iron may be separated by the lixivium of Prussian blue I. pursuant to Exp. 42.

### *Aluminous Earth.*

The separation of *Earth of Alum*, from such stones as consist for the most part of this earth, is in like manner undertaken with the vitriolic acid F. when the earth uniting with the vitriolic acid forms alum. Any *siliceous earth*, that

may be present, remains undisolved behind, and iron is separated pursuant to Exp. 42.

*Ponderous Earth.*

When *Ponderous Earth* occurs combined with fixed air, it may be treated in the same manner as calcareous earth. But this earth is particularly remarkable in this respect, that it has so great an affinity to the vitriolic acid, and forms with it a ponderous spar so difficultly soluble in water. If therefore ponderous earth occurs together with other earths dissolved in an acid, and a few drops of the vitriolic acid F. are added, the latter unites with the ponderous earth (Exp. 83), and falls with it to the bottom of the vessel; after which the other earths, that may still happen to be present, may be separated in the manner above mentioned. This earth generally occurs combined with vitriolic acid in the form of ponderous spar; and the former may be separated from it in the moist way in the same manner as calcareous earth, by the mild vegetable alkali O. by means of a mutual affinity.

*Siliceous Earth.*

*Siliceous Earth* being insoluble in all the acids, except the fluor acid, it may easily be separated from minerals, as it will for this reason always remain undissolved behind. In other respects it may be distinguished from the rest of the earths, by its fusing readily, when submitted to the blow-pipe, with alkaline salts or fluxes, into a siliceous mass or glass.

*Minerals of a more mixed Nature\*.*

If, for instance, a mineral substance consists of *Calcareous Earth, Magnesia, Gypsum, Siliceous*

\* That it may be seen at one view, in how many different ways the products of the mineral kingdom occur mixed in nature; M. *Emmerling* has reduced into tables all the products of the mineral kingdom, hitherto chemically analysed by *Bergman, Wieglob, Kirwan, Achard, Klaproth, Westrumb, Heyer, Bayen, &c.* which tables M. *Hoffmann* has revised, enlarged, and enriched with notes. These products are divided into three classes, *viz. Earths and Stones, Inflammable Substances, and Metals*; and these tables are to be found in the *Miner's Journal*, Year II. Vol. I. Part V. p. 417, under the following title: *A Systematic Catalogue, in the Form of Tables, of all the simple Fossils hitherto analysed.* Besides this,

M. *Remler*

ceous Earth, Iron, &c.; upon a small quantity of this mineral, which has been previously reduced in the glass mortar to a fine powder, pour as much aqua regia as will cover it; which may be made of one part of the nitrous acid contained in the collection, and two parts of the marine acid. Now aqua regia will dissolve all the constituent parts that are soluble in acids, viz. calcareous earth, magnesia, aluminous earth, and iron, and leave the insoluble parts, such as siliceous earth and gypsum, undissolved behind. After this, precipitate every thing out of the solution with the vegetable fixed alkali O. and put it upon a filter of white blotting-paper; when the liquid will run through the filter, and the earths, that were held in solution, remain behind; upon which

M. Remler has published a similar table of such earths and stones as have been investigated, arranged in alphabetical order, under the following title: *A Table determining, in One Hundred Grains, the Proportion and Quantity of the component Parts of such Stones and Earths as have been accurately analysed of late; drawn up, so as to be seen at one View, for the Use of Natural Philosophers, Mineralogists, Technologists, and Naturalists, by I. C. W. Remler. Erfurth, 1790.*

as much distilled water is to be poured, till it runs off from them quite tasteless. Now if upon this precipitate, when dry, a little of the diluted acetous acid M. is poured, and the mixture is set by in a warm place, the calcareous earth and magnesia, that are present in it, will be dissolved in the acetous acid; but the aluminous earth and the iron will remain undissolved behind, which are to be separated from it by filtration. The liquor that has passed through the filter evaporate to dryness, and pour a little of the vitriolic acid upon it: by this means the acetous acid will evaporate; but the vitriolic acid combining with the calcareous earth, that is present, will form selenite (Exp. 23), and, with the magnesian earth, Epsom salt. Upon that part which has been left undissolved by the acetous acid, pour a little marine acid, and it will be perfectly dissolved in it: this solution dilute with distilled water, and add to it drop by drop the lixivium of Prussian blue, till no more blue precipitate is separated from it (Exp. 42): but from the liquid, which remains after the separation of this blue precipitate of iron, throw down the aluminous earth by means of the alkaline salt O. And now the

*first*

first residuum, which still contains siliceous earth and gypsum, is to be examined. Pour upon it a little of the mild vegetable alkali O. and set it by in a warm place: the alkali will by this means, as was the case above with respect to the gypsum, combine with the vitriolic acid, and form vitriolated tartar, and the calcareous earth will be separated. But this separation taking place but slowly, the liquid, in case it is evaporated, must be replaced again by the addition of distilled water; and this must be repeated till such time as the gypsum, that is contained in this mixture, is entirely decomposed. The vitriolated tartar thus generated, and the uncombined alkali that may still happen to be present, are now to be washed off, and the residuum to be dried: upon this residuum pour a little of the diluted acid of vinegar M.: by this means the calcareous earth will be dissolved, and the siliceous earth will remain behind in a pure state. The calcareous earth may now be separated from the vinegar, by precipitating it with the alkaline salt O.; and in this manner the whole mineral will have been decomposed in *the moist way*. If this process is conducted carefully, the quantity of the substances

that are present may, if not completely, yet in some measure, be determined.

Some excellent instances of the analysis of stones and earths are contained in *Bergman's Works*, as likewise in *Crell's Chemical Annals* by *Wieglob*, *Klaproth*, *Westrumb*, &c. which ought to be consulted on this subject: but besides this M. *Westrumb* has brought together what is most necessary for this purpose, in an appropriate treatise, contained in his *Physico-chemical Essays*, vol. ii. part ii. Leipzig, 1788, p. 221; and vol. iii. part i. p. 319, under the following title: *A short Introduction to the Chemical Analysis of Stones and Earths in the moist Way.*

From the easy fusibility of earths and stones, or from the property, which several of these bodies possess, of vitrifying in the fire, either alone or with the addition of salts, or even of earths of a different kind, the mineralogist is able in like manner to conclude variously of their constituent parts; and for this purpose small trials with the blow-pipe are frequently sufficient. In the investigation of a mineral it is usual to begin with this, and to determine what results the mineral gives, either by itself,

or

or with the fluxes contained in the collection, viz. *calcined borax*, *microcosmic salt*, and *mineral alkali*.

Now, as the bodies appertaining to the mineral kingdom, according to the so multifariously different mixtures of their constituent parts, afford also quite different results, when submitted to the action of the blow-pipe; it would be necessary to lay down here a whole system of mineralogy: but this being contrary to my plan at present, I beg leave merely to refer the reader to the following authors:

*Gustavus von Engestroem's Description of a Mineralogical Pocket Laboratory, and especially of the Utility of the Blow-pipe in Mineralogy; translated from the Swedish, and furnished with Notes, by M. Weigel.* Greifswald, 1782.

*Bergman, Comment. de Tubo ferruminatorio ejusdemque Uso in explorandis Corporibus, præsertim Mineralibus.* Vindob. 1779. 8vo. *Opusc. Phys. & Chem.* vol. ii. p. 455.

*Sauvage's Improved Construction and Use of the Blow-pipe, in Crell's Supplements to the Chemical Annals, part ii. p. 1.*

## III.

*Use of the Collection to Metallurgists.*

By means of Metallurgy, metals are separated from the other substances with which nature has often combined them ; and as this separation in like manner depends upon chemical principles, the metallurgist also must be acquainted with the properties of metals, and particularly with their effects on the different re-agents, in order to assure himself of their presence, and to know whether it be worth while or not to assay an ore in the moist way for metal. Now, in investigations of this kind the ores must always be freed as much as possible from the earthy or stony particles that are mixed with them ; for, the separation being effected by solution in acids, these earths will be dissolved at the same time, and render the investigation difficult.

*Gold.*

*Gold* is to be dissolved in no other way than in aqua regia, which may be composed, according to the prescription given above, of nitrous and marine acid. Ores therefore which are supposed

supposed to contain gold, are put into a quantity of aqua regia sufficient to cover them; by which means the gold will be dissolved, and the solution is to be diluted with distilled water. Now, if a few drops of a solution of tin \* are added to this solution, the gold that is present will discover itself by a *violet-coloured precipitate* (the *purpura mineralis*, or mineral purple). This powder, when it is dried, and mixed with calcined borax, fuses, when urged by the blow-pipe, to a glass of a *ruby colour*; and therefore also this powder is particularly made use of for the painting of genuine porcelain. Gold is besides precipitated from its solution in a *metallic form* by pure martial vitriol dissolved in distilled water.

\* It is necessary that the solution of tin employed for this purpose be prepared with all possible care, particularly avoiding the least degree of heat; on which account it is advisable to set the phial, in which the solution is made, in cold water. The aqua regia must be mixed in due proportion, so as not to be immoderately strong; and the tin, which should be of the purest English sort, must be added to it in small portions only at a time. The phial in which the solution is performed, must be filled with the aqua regia up to one half or two thirds; and no fresh tin must be added, till the first portion is entirely dissolved.

*Platina.*

*Platina* in like manner is soluble in aqua regia only, and may be precipitated from it by a solution of sal ammoniac. (For this purpose, dissolve a little of the sal ammoniac D. D. in distilled water.) By itself platina can be fused by the blow-pipe, by means of pure dephlogisticated air only.

*Silver.*

*Silver* may be separated from its ore by the nitrous acid G. and precipitated from it by marine and vitriolic acid in the form of *Luna cornea* and *Vitriol of Silver* (Exp. 88, 89, 90, 91). Copper precipitates it from its solution in a metallic form.

*Copper.*

*Copper* produces with the nitrous acid G. a *green*, and with the vitriolic acid F. a *blue* solution. If a little of the solution of volatile alkali P. is poured upon a small portion of an ore that is suspected to contain copper, it will be tinged blue by it (Exp. 72. 76. 127). The same may be said of the solution of such ore in the vitriolic or nitrous acid, when mixed with this salt. By polished iron it is precipitated

tated from its solution in its *metallic form*. When fused by the assistance of the blow-pipe, it imparts a green colour to the flame.

### *Lead.*

*Lead*, when contained in an ore, may be dissolved by the acetous acid M. and forms with it a sweetish *salt* (Sugar of Lead). Lead is more perfectly separated from its ore by means of the nitrous acid; and from this solution it may be precipitated by the marine and vitriolic acids, or by the neutral salts composed of them, pursuant to Exp. 110 and 111. By the liver of sulphur G. G. or the hepatic water H. H. it is precipitated of a *blackish-brown colour*. By zinc it may be separated from its solution in its *metallic state*. When urged with the blow-pipe, it froths up, and emits a yellowish light.

### *Tin.*

*Tin* is dissolved only in aqua regia, and by the nitrous acid G. it is corroded to a *white calx*. Exposed to the action of the blow-pipe, it is easily calcined, and the different fluxes fuse with it to a *white opaque mass*.

### *Iron.*

*Iron.*

Iron produces with the vitriolic acid a *green*, and with other acids, the marine for instance, a *brownish* solution, and the solution has a peculiar astringent *taste of iron*. In the form of calx, in which form it usually occurs in nature, it is dissolved with difficulty by the vitriolic and nitrous acids, but more readily by the marine acid and aqua regia; and for this reason these latter acids are generally made use of, in examining a mineral containing much iron. By the vegetable alkali O. it is precipitated of a *greenish*, and by the lixivium of Prussian blue I. of a *blue* colour (Exp. 42): but the former of these precipitates assumes a *yellow* colour, on being dried in the air. With the astringent matter contained in vegetables, it produces a *black* colour (Exp. 48). To the different fluxes, when urged by the blow-pipe, a *green* colour is imparted by iron; but the longer it is calcined, the nearer do these approach to a *dark yellow hue*. Calcined iron, by urging it with a red heat on a piece of charcoal by means of the blow-pipe, is brought into a state in which it is attracted by the magnet.

*Mercury.*

*Mercury.*

*Mercury*, as it generally occurs mineralised with sulphur in the form of native cinnabar, is pretty readily recognizable by the red colour of this latter substance, besides that it is difficult to separate it in the moist way: Bergman\* effected this by boiling the cinnabar with aqua regia; and when mercury has once been dissolved by this means, its presence may be discovered by the Experiments 35, 36. 104. Exposed to the action of the blow-pipe, it ought to fly off entirely.

*Bismuth.*

*Bismuth* may be separated from its ore by nitrous acid, and is precipitated from this solution, by the addition of distilled water only, in the form of a white calx. With microcosmic salt or borax it fuses, on being urged with the blow-pipe, forming a *glass-like mass*, which, on being smelted upon a piece of charcoal, fumes, and emits a light.

*Zinc.*

*Zinc* in its mineralised state is not readily discoverable in the moist way; but in its me-

\* Opusc. Phys. & Chem. vol. ii. p. 432.

tallic state it is soluble in all acids, and by the spirit of wine I. I. it is gradually corroded in consequence of a continued digestion, and converted into a white calx. When urged with the blow-pipe upon a piece of charcoal, it burns with a *blueish green* colour, and a white woolly calx is formed, called Flowers of Zinc. It gives a *yellow* tinge to copper in fusion, and may be afterwards separated from the copper again by means of quicksilver.

*Regulus of Antimony.*

*Regulus of Antimony* is extracted in combination with sulphur by the caustic alkali N.; and from this solution it may be separated in combination with the sulphur, by any acid whatever. With concentrated marine acid it forms *Butter* or *Oil of Antimony*, and may be separated from the acid in the form of a white calx (*Pulvis Algaroth*) by the addition of water only: its presence also will be manifested by the Experiments 139 and 148. Exposed upon charcoal to the action of the blow-pipe, it flies off in *white fumes*; and amidst a succession of bubbles deposits beautiful flowers on the surface of any body that is held near it.

*Regulus*

*Regulus of Arsenic.*

*Regulus of Arsenic* imparts a *red* colour to sulphur, and a *white* one to copper. Its calx (or white arsenic), when it is perfectly dephlogisticated, acts like an acid. For the mode in which it may be discovered in liquids, see the Experiments 116, 117. 131. 138. 144. Exposed to the action of the blow-pipe, it flies off with *white fumes of a garlic-like odour*.

*Regulus of Cobalt.*

The *Regulus of Cobalt* is soluble in the vitriolic and nitrous acid, as also in aqua regia. With the vitriolic acid it forms a *red salt*. The solution of it in aqua regia is of a *peach-blossom colour*, and, if evaporated, yields a saline residuum, which becomes *green* when it is made warm, and of which the colour *disappears again*, as soon as this salt becomes cold. The latter property makes this solution fit to be used as a *sympathetic ink*. It fuses with borax, or any other flux, when urged by the blow-pipe, forming a *blue glass*.

### *Regulus of Nickel.*

The *Regulus of Nickel* imparts, like copper, a *blue* colour to the caustic volatile alkali P.; but with the vitriolic acid F. it produces, instead of a *blue*, a *green* solution. By calcining the vitriolic salt of Nickel, not a *brownish red* but a *green caput mortuum* is yielded; and it forms with borax or microcosmic salt, when urged with the blow-pipe, not a *green* but a *hyacinth-coloured glass*. If it contains arsenic, it is volatilized, so as to produce vegetations in the form of trees.

### *Manganese.*

*Manganese* is distinguished by its dephlogisticating the marine acid, and producing a *black calx*, when urged with the blow-pipe. Fused to glass with borax or other fluxes by means of the blow-pipe, it yields *with the point of the flame* a *red glass*, which with the interior part of the flame becomes *white* again.

On the subject of assaying of ores *in the moist way* may be consulted, the Essays in *Bergman's Opusc. Phys. & Chem.* vol. ii. entitled, *De Precipitatis Metallicis*, p. 349, and *De Mineralium Docimasia Humida*, p. 399.

On

On the arts of assaying and smelting in general may be consulted, *Gmelin's Chemical Elements of the Arts of Assaying and Smelting.*

#### IV.

##### *Use of the Collection to Technologists, or Projecting Artists.*

The Technologist occupies himself in searching after and investigating the various productions of nature—not in order to arrange them in a convenient system, but with a view to improve and manufacture them to the advantage of the country he lives in, and to render them of general utility. And as in these days many productions, improved by art for the convenience of mankind, are become articles of indispensable necessity, they are now manufactured in every country. But between these artificial productions there is, for the most part, a great difference discoverable with respect to their goodness and perfection; and when this difference is accurately investigated, the cause of it is found to consist merely in the genuineness and purity of the materials which have been employed in the manufacturing of them, or in

the mutual proportion of their constituent parts. Now the genuineness of the materials, as well as the proportions to be taken, in order to make the products of our own country resemble those of foreign regions, we discover by means of chemical researches. By these we find whether the absence or the presence of a constituent part is the cause of such difference; and by these likewise we are enabled to correct as well the one defect as the other. Most of the cases, mentioned in the preceding pages, are objects of investigation for Technologists. The investigation of *waters*, the examination of *wines*, the analysing of *earths* and *stones*, the discovering of *metals*, the knowledge of *salts* and their genuineness, are all fit objects for Technologists: I need therefore only refer to the instances given above.

On the subject of Technical Chemistry may be read :

*Gmelin's Principles of Technical Chemistry.*  
Halle, 1786.

*Succow's Outlines of Oeconomico-technical Chemistry.* The second edition, enlarged. Leipzig, 1789.

## V.

*Use of the Collection to Manufacturers.*

The Manufacturer is distinguished from the Technologist, or Projecting Artist, in this respect, that this latter endeavours to improve all the materials produced by nature, while the Manufacturer usually confines himself to a single article only. Now, if he would not wish to treat them as a mere workman, but bring the productions he manufactures continually nearer and nearer to perfection, he must in like manner very often have recourse to Chemistry. Indeed, it is for the most part owing to trivial circumstances, that many processes miscarry under his hands: but it is particularly important for him to know, whether the *water* he uses in his business be sufficiently pure, or in how far or with what substances it is contaminated, and what influence this can have upon the better manufacturing of his materials. It is also of importance to him, to obtain the *materials* he uses in as pure a state as possible, or to bring them, by previous processes, to the requisite degree of purity. The Silk-dyer, for

instance, is well aware, what a favourable influence the *purity of the water* and that of *his most necessary materials* have upon the success of his dye: and thus, again, there is a whole series of processes besides, in which particular respect must be had to this object. An extremely pure water may be discovered by Exp. 40. 46. 49. 53. 55. 62. 67. 73. 77. 82. 87. 95. 103. 109. 115. 118. 121. 125. 134. 136. 142: and how the noxious admixture is to be found out, and, if possible, separated from it, the Experiments described above will, in general, inform him. Instructions for discovering the genuineness of the materials necessary for his purpose, *viz.* VITRIOLIC ACID, NITROUS ACID, MARINE ACID, VINEGAR, SALT OF TARTAR, MINERAL ALKALI, VOLATILE ALKALI, GLAUBER'S SALT, SALTPETRE, SAL AMMONIAC, ALUM, BORAX, CREAM OF TARTAR, WHITE VITRIOL, CORROSIVE SUBLIMATE, SUGAR OF LEAD, BLUE VITRIOL, QUICKSILVER, CINNABAR, WHITE LEAD, RED LEAD, TIN, VERDigrise, IRON, MILK OF SULPHUR, &c. have been already given above.

The above-mentioned Treatises upon Technical Chemistry, by *Gmelin* and *Succow*, I recommend

commend likewise to the attention of the Manufacturer.

## VI.

### *Use of the Collection to Farmers.*

It is well known to the practical Farmer, how much depends upon the goodness and proper mixture of the soil, with respect to promoting the growth of plants. Soils are generally divided, with respect to their constituent parts, into *chalky*, *clayey*, *sandy*, and *mixed soils*. Now, of these, that which is properly mixed is preferable to the others. *A chalky soil* is not the most fertile, as it is heavy, and prevents the spreading of the small fibres of the root: it is penetrated but slowly by moisture, but retains it afterwards so much the longer. *A clayey soil* is soon penetrated by water, but retains it too long, and does not allow it to drain off again slowly. It is heavy at all times; and when at length it is entirely dried up, it becomes too hard, and cracks. *A sandy soil* absorbs water readily, but parts with it again too soon. It also receives more heat than another soil, and for this reason is at most times deficient in moisture. But a well *mixed soil*,

*soil*, which ought to consist of about equal parts of *lime*, *clay*, and *sand*, usually possesses all the good qualities of a soil united. It absorbs moisture readily, does not retain it too long, nor prevent the spreading of the small fibres of the root, neither does it crack. But as the proper proportion of a soil cannot be discovered otherwise than by chemical investigation; on this account it is requisite for the cultivator of land to possess some knowledge of chemistry, and particularly of the effects and properties of the re-agents occurring in this collection. Now, in order to assure himself, by means of these re-agents, of the component parts of the soil he occupies, he has no more to do than implicitly to follow the analysis of *earths and stones*, which has been indicated above in the chapter explaining the use of this Collection to Mineralogists; for which reason it would be superfluous to repeat them in this place. As an imitable pattern of Analyfes relative to this subject, may be read,

*Andrea's Treatise concerning a considerable Number of Earths found in His Majesty's Hanoverian Dominions, &c. and their Use to the Husbandman.* Hanover, 1769.

But

But the rural œconomist may meet with many other occasions besides, in which the re-agents contained in the Collection may be of service to him. Linen and clothes, for instance, are frequently, in the course of housekeeping, liable to be foiled by *grease*, *wine*, *iron* and *ink*; and the removal of these spots depends in like manner upon chemical principles.

*To take Spots out of Linen.*

In order to take *spots of grease* out of linen, the spots are to be moistened with a few drops of the vegetable alkali N. rubbed between the fingers, and then washed out immediately. Here the alkali, uniting with the grease, will form a soap, which may be then washed out with water.

*Stains made by red wine* may be taken out by means of a weak acid. A little of the *nitrous*, *marine*, or *acetous acid* contained in the Collection is to be diluted with twice its quantity of water, and the spot moistened with it; and, after being rubbed a little between the fingers, to be washed out immediately with water. In case all the colour produced by the wine does not entirely

entirely disappear in consequence of the first application, the operation is to be repeated a second, or even a third time, till the stain is entirely gone.

*Iron-moulds* are removable by means of the marine acid contained in the Collection. The spot is to be moistened with it, rubbed between the fingers, and washed out with clean water. The iron-mould or rust is dissolved by the acid, and the spot disappears.

*Ink spots* are best taken out by the nitrous acid G. This is to be diluted with four times its quantity of water, and the spot moistened with it, which is then to be rubbed between the fingers, and washed out immediately.

### *Cleaning of dyed Woollen, Silken, and other Stuffs.*

Dyed cloths and stuffs require far more attention than uncoloured linen or cotton does, because in the former the object is not only to take out the spot, but also to preserve the colour. These cloths or stuffs may be soiled by *grease, wine, vinegar, lemon-juice, or an alkaline liquor.* Spots of *grease* may be taken out by the *spirit of wine* I. I. by moistening the spot carefully with it, and, after rubbing the part gently, washing

washing the spot out with clean water. If the grease has already taken too fast hold of the cloth, it may first be diluted with a few drops of oil of turpentine, and then be taken out with spirit of wine. But stains occasioned by *vinegar*, *lemon-juice*, or *wine*, require far greater attention. In such colours as consist chiefly of materials that are changed by acids or alkalies, the production of such spots, as well as the removal of them, depends upon this action. If the stain was made by *wine*, *vinegar*, or *lemon-juice*, the acid has in this case produced the change and the spot: now, if the acid be taken away again carefully by alkaline salts, with which it is most inclined to unite, the spot must disappear likewise. But here it is necessary previously to inquire, whether the alkaline salt too, that is to be employed, will not destroy the unchanged colour, and produce a new spot. Now, in order to take out spots of this kind, mix about ten drops of the *caustic volatile alkali* P. with twenty drops of the spirit of wine I. I.: with this mixture wet a clean linen rag, and rub the spot with it carefully. If the spot is occasioned by *alkaline substances*, a little of the *acetous acid* M. may be diluted with

water,

water, a clean rag wetted with it, and the process be carried on in the same manner as directed above.

To any one who is desirous of reading any thing more on the subject of these inquiries so highly useful to all who are occupied in agriculture, as well as to the masters and mistresses of families, and of the appearances that occur in the course of these same inquiries, I cannot recommend a better book, or one in which perspicuity and brevity are more happily united, than the elementary treatise above mentioned of *Succow*.

### VIII.

#### *Use of the Collection to the Cultivators of Natural Philosophy.*

Those who study Chemistry merely from motives of curiosity will, by repeating the experiments pointed out in this Treatise, find sufficient opportunity of amusing themselves, not only in a very instructive, but also in a most pleasing manner. As this Chest, on account of its commodious arrangement, is very convenient to take with one in travelling; such persons in particular as are used to visit water-

ing-places will have frequent opportunity of making themselves acquainted with the products which nature has frequently in various ways bestowed, and that sometimes even with a lavish hand, upon these spots. By means of the many different changes of colours, that take place in colourless liquids, when combined with other substances, a great variety of amusing experiments also may be made, which, if they are not undertaken entirely without thought or design, may prove useful and instructive. In order to avoid increasing the bulk of this Treatise, I shall forbear to point out here the many instances that might be given of this; but refer those who are desirous of acquiring information on this subject, to the *Chemical Tricks and Deceptions*, collected by *Wieglob* and *Rosenthal*, in the First, Second, and Third Parts of *Wieglob's Natural Magic*.

THE END.



